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Tie Renewals

THE problem of tie renewals is the biggest problem in the maintenance of way departments at this time of the year, and there are a number of ways in which this work may be made more efficient or satisfactory.

It is hardly necessary to mention the fact that care should be used in spotting the ties which are to be renewed; cursory examination of the top of a tie sometimes seems to indicate that the tie is unsound, but investigation will frequently show that ties which appear unsound on top are sound in the interior.

The question of labor is the most important one. It is highly desirable, but frequently impossible, to hire extra men early in the season for this work. Better men can then be obtained, the weather is cooler and more work can therefore be done, and a greater period of time is given for the new ties to get solidly bedded before the winter season. During the late summer and fall, all or the greater portion of the time of the track men should be devoted to surfacing and smoothing up track and ditching.

Drainage is a most important feature of track work, and it is agreed that autumn is the time to get track ditches, surface ditches, and all openings through the roadbed cleaned and opened up. If tie renewals are delayed, drainage work is the work which suffers, as it is the last scheduled work of the open season.

Tie renewals should be handled entirely by section gangs. This is the usual method, but occasionally the work gets several years behind on a section, due to lack of laborers or other causes. An extra gang delegated to such work will generally show considerably higher costs and not quite as good work as the section gang. The reasons for this are lack of sufficient supervision, and the fact that extra gang laborers are usually not as careful and thorough as section men.

Proper distribution of ties necessitating the least rehandling, will be a great aid to the work of tie renewals. Painstaking care on the part of the crew doing this work will be amply repaid by a more than equal reduction in cost of the renewal work.

The responsibility for the work lies on the section foreman, and if he is doing his best and striving to do better, he should be given all possible instruction and support by the roadmaster. A careless or indifferent foreman can easily cost the company more money than his salary in any kind of work, and especially is this true in tie renewals.

A better method of obtaining laborers will result in obtaining better laborers. Much of our labor is being preyed upon by labor agents and commissary men, who levy a heavy toll on the laborers. This practice cannot be too strongly condemned. Aside from its unfairness to the laborer, the railways pay this money in the same manner that a tax or duty on common goods is in the end paid by the consumer. A laborer who is mulcted out of a considerable amount of his wages is bound to be dissatisfied and the net value of his work is likely to be below the amount of money which he receives for himself after paying the duty.

Raising the Ballast Deck of a Trestle

THE use of a derrick for raising the ballast deck of a trestle, described and illustrated on another page of this issue, opens up another place for the advantageous and economical substitution of power for manual labor.

The ordinary method of raising this trestle with jacks would not only have been slower, but according to estimates would have cost much more money. Handling jacks on this trestle would have been difficult, of course, due to lack of room to work in. The whole operation seems to have been simplified by the method chosen.

A similar method might be advocated for raising tracks in track elevation, etc. This proposition would be much more difficult, however, due to the poor foundation under the track on which the derrick would be placed. This would be especially true with the class of dirt generally put into fills. The concentration under the front wheels would be quite severe, when making a lift, but this does not matter on the trestle where the foundation is on piles with firm bearing. On dirt fills the load might easily exceed the resistance of the fill, and might frequently cause settling which would throw the derrick off the track.

Purifying Water for Locomotives

THE erratic results which have followed the installation of water softening plants would seem to indicate faulty design in some cases. Excellent results are obtained in some cases while in others the results have led to the abandonment of the plant.

There are a number of reasons for this difference in results. A single, isolated plant on a division of a railway may not produce results, due to the water furnished the locomotive on the balance of the division. The purified water has a tendency to loosen and detach some of the scale which is being accumulated on the remainder of the division. Trouble therefore, sometimes seems to be increased, following the installation of the softener. A similar effect may be produced for a short period following the installation of softeners over a whole division, due to loosening of scale previously accumulated in the boilers.

As pointed out in the article on another page of this issue, agitation of the solution, after the addition of the chemical, is very necessary if sedimentation is to take place within a reasonable time. The reproductions from the photographs show and emphasize this fact very forcibly.

The utilization of old storage tanks in the design of the water softener, while reducing the first cost, would seem of doubtful economy, especially if the desired capacity will cause the rate of upflow to be too fast to allow complete sedimentation to take place. In other words, if the upward movement of the water is nearly or quite as great as the rate of sedimentation, the particles will pass from the mixing tank while still containing the objectionable matter, not in solution, but in suspension. These facts indicate that the diameter of the softening tank should be proportioned in accordance with the capacity desired, and the rate at which the separated particles will settle.

The author states in his article that it is practically impossible, at present, to make an estimate of the exact benefits to be derived from softening water, due to the fact that exact records are not available as to the cost of locomotive repairs chargeable to bad water. It is possible to determine about what minimum amount of impurities will render purification profitable, but it is not possible to state the exact amount of benefit to be derived in a given case.

Twenty Years Ago This Month

(From the Files.)

The receivers of the Union Pacific were instructed by court decision to restore the wages of all employes cut in September, 1893.

The Mound North tunnel of the North British line at Glasgow was completed this month. This is a cast-iron tube through an artificial embankment which carries the national gallery and a main thoroughfare of Glasgow. The tunnel is made up of cast-iron segments 17 ft. 6 in. in diameter, four feet long and 18 in. wide, bolted together with flanges 7 in. deep and 1⅞ in. thick.

A new device for automatically stopping trains consists of a thin wedge-shaped device strong enough to open an air cock in the brake line but weak enough to collapse under the truck wheels. The wedge is designed to be placed on the rail by the crew of the train which needs protection.

Jas. E. Howard, of the Watertown Arsenal, has made extensive measurements of the deflection of rails under load. The rails tested were those in Hawthorne yards of the Chicago, Burlington & Quincy and were of 66 and 75 lbs. weight, layed in both cinder and gravel ballast.

The Illinois Central contemplates elevating its suburban station platforms and taking off the steps from the cars.

The Van Buren St. tunnel in Chicago was opened April 21. The tunnel contains two cable tracks and including expenses of litigation it is said to have cost $1,500,000.

W. H. Stearns, recently superintendent of bridges and buildings on the Chicago & North Western, has become mechanical engineer of the Buda Foundry & Mfg. Co.

H. M. Sperry, who has been for some years connected with the Johnson Signal Co. has tendered his resignation to become western agent of the National Switch & Signal Co., with offices in Chicago.

The Chicago Great Western has decided to locate its new shops at Oelwein, Iowa.

The Metropolitan Elevated of Chicago has decided to adopt electric power. W. E. Baker, who was general manager of the Intramural during the World's Fair will have charge of the electrical equipment.

The first year's trial of Philadelphia's pneumatic tube postal system has been completed and it has been so successful that plans are being made to extend its use for commercial purposes.

Work on the drainage canal at Chicago is now in actual progress.

W. C. Cushing, engineer maintenance of way of the Indianapolis division of the Pennsylvania, has been tranferred to the Pittsburgh division. He has been succeeded by M. L. Byers.

Track laying at the rate of 10,000 feet in ten hours was done on the Southern Pacific's line to San Luis Obispo, Cal., on May 3, in order to keep an agreement to have trains running on May 5.

FRANK H. CLARK, formerly sales manager of the railroad department of the Watson-Stillman Company, New York, has purchased the Chambers throttle valve business of that company. He has formed the Chambers Throttle Valve Company, of which he is president.

Purification of Water for Locomotives†

*P. M. La Bach, Assistant Engineer, C., R. I. & P. Ry.**

Scientific investigation tells us that pure water practically does not exist in nature. Snow and rain water in falling absorb the gaseos substances in the air. These are usually carbonic acid, nitric acid and ammonia. In addition to this, water is a weakly oxidizing agent itself. Some of the impurities, such as carbonic acid, aid in dissolving a number of substances which are found in ordinary soil. A further addition of carbonic acid to surface water on its way into the earth is made by absorbing decaying vegetable matter. Having acquired acid properties, the water readily absorbs various mineral substances which are found in ordinary soils, including salts of lime and magnesia. When once dissolved, these substances are colorless as a rule, and do not make their presence known. Custom has given the term "hardness" to the amount of salts in solution and we have "total hardness," "temporary hardness," etc., now used as technical terms. Table I shows the maximum amounts of different mineral substances which may be dissolved in pure water. These substances are found in varying quantities in nearly all water except that caught immediately upon falling.

Table I—Solubility in 1 U. S. Gallon at 60° F.

Calcium carbonate, $CoCO_3$	2.1 grains
Calcium chloride, $CaCl_2$	33.3 lbs.
Calcium sulphate, $CaSO_4$	134.1 grains
Magnesium carbonate, $MgCO_3$	Doubtful
Magnesium chloride, $MgCl_2$	16.6 lbs.
Magnesium sulphate, $MgSO_4$	2.5 lbs.
Sodium carbonate, Na_2CO_3	1.0 lb.
Sodium chloride, NaCl	2.9 lbs.
Sodium sulphate, Na_2SO_4	0.9 lb.

As the solutions in the table are for ordinary temperatures, it is apparent that when present in the earth of the neighborhood or in the rocks underneath the surface, that any supply of water taken from a well or running stream is apt to contain impurities in liberal quantities.

Rocks are worn away by the mechanical action of heat and freezing and are first oxidized, either by the oxygen of the air or by water. After this the hydrates of these substances are formed and solutions are made. In addition, there are a number of solutions of acids which may be either organic or inorganic in origin. These, in combination, form new substances which are soluble in water. The older chemists use the terms temporary and permanent hardness in referring to these compounds. Temporary hardness was understood to be the difference between the total hardness and permanent hardness, while permanent hardness was that portion not precipitated by boiling. The effect of boiling is to drive off the carbon dioxide and precipitate the carbonates. In a great many of the reports, however, only the total hardness is given. The different units and their method of calculation properly belong to unabridged editions of books on this subject, but for reference the standard units are found in Table II.

Table II—Standards of Hardness.

German: One degree of hardness is the solution of one (1) part calcium oxide (CaO) in 100,000 parts of water, or .01 gram in one litre.

French: One degree of hardness is the solution of one (1) part calcium carbonate ($CaCO_3$) in 100,000 parts of water, or .01 gram in one litre.

English: One grain of calcium carbonate per "Imperial" gallon of 70,000 grains.

American: One grain of calcium carbonate per "U. S." gallon of 58,381 grains.

The American and English standards are in the same unit as the French, $CaCO_3$, and in the proportion 58,381:70,000:100,000. One degree of French standard for hardness equals 1.79 degrees of the German.

There are innumerable substances found in water polluted by sewage and mill-waste, but each forms a separate problem and no general rules can be applied.

The impurities found in water may be classified thus:

I. Suspended matter:
- (a) Organic matter,
  1. Animal matter,
  2. Vegetable matter,
  3. Micro-organisms,
  4. Algae.
- (b) Inorganic matter:
  1. Mineral matter,
  2. Mineral oils,
  3. Clay,
  4. Sand,
  5. Silt.

} Removed by Mechanical Filtration.

II. Dissolved substances:
- (a) Gases
  (1) Oxygen,
  (2) Carbon dioxide,
  (3) Chlorine,
  (4) Hydrogen sulphide,
  (5) Ammonia,
- (b) Solids
  (1) Organic,
  (2) Inorganic.

} Removed by heating or precipitated by chemical reagents.

Professor Edward B. Warman gives the following interesting classification:

"Raw water is an aquarium.
Boiled water is a grave-yard.
Mineral water is premature old age.
Filtered water is a gay deceiver.
Distilled water is purity."

Boiler waters are usually divided into four classes when reference is made to the soluble impurities which cause trouble when in solution, these impurities being (1) Incrusting solids, (2) Inert substances, (3) Corrosion substances, (4) Substances causing priming and foaming.

Incrusting solids are those which form a coating or scale in the interior of the boiler through the action of either the heat or pressure. They are usually of two kinds, those forming hard scale or those forming soft scale.

Inert substances are those which are harmless and have no action on the boiler. Their only effect is to raise the temperature of the boiling point. (3) and (4) are usually called non incrusting substances. They are defined as follows:

A corrosive substance is one which causes deterioration of the steel of the boiler either by chemical or electrolytic action.

"A boiler is said to prime when water is carried as steam-bubbles, with the steam up through the water to its surface, and may be considered as affecting the entire depth of the water in a boiler."

Foaming is the result of suspended impurities in the water, which rise to its surface in a more or less dirty condition and form a scum. Pure water cannot produce foam; steam from a boiler which foams is dryer than that from a boiler which primes."

Inorganic Impurities Found in Water.

Calcium Bicarbonate, $Ca(HCO_3)_2$, is in practically every natural water. In nature the carbonate of lime is usually in the form of limestone, marble or chalk which are only slightly soluble in pure water. Water containing carbonic acid gas or carbon dioxide, CO_2, readily dissolves them and forms the bicarbonate. When

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subjected to a temperature of about 200 degrees F. much of the CO_2 is driven off and the carbonate precipitated. The same action is produced by chemical reagents as shown in Table III. This substance forms soft scale or mud in a boiler, unless in combination with other substances, when it may form a very tough and resistant scale.

Magnesium Bicarbonate, $Mg(HCO_3)_2$, is more soluble in water than the calcium bicarbonate. It is formed from the carbonate in a manner similar to that of the calcium bicarbonate. Magnesium carbonate is a well known toilet preparation. Also it is used as a covering for steam and other pipes on account of its being a good non-conductor of heat. When heated, it breaks up into magnesium hydrate, magnesium oxide and carbon dioxide. It also has a tendency to cause foaming. It is precipitated by the different reagents found in Table III.

Calcium Sulphate, $CaSO_4$, is generally known as gypsum, alabaster or plaster of Paris. It is responsible for the formation of the hardest kind of scale. It is more soluble at low than at high temperatures and pressures and when the pressure in a boiler passes above 50 lbs. it begins to precipitate. Practically all of it precipitates at 300 degrees F. It is a poor conductor of heat and adheres to the shells and tubes of boilers.

Magnesium Sulphate, $MgSO_4$, is commonly called epsom salts. It is readily soluble in both warm and cold water and does not of itself form scale in boilers. It belongs to the third division given above as it has marked corrosive action. In the presence of lime it forms a scale as $Mg(OH)_2$. This action is shown in Table III.

Calcium Chloride, $CaCl_2$, is very soluble in water and corrosive in its action. It does not form scale under ordinary circumstances. However, when heated with magnesium sulphate, a transfer of acids takes place and calcium sulphate and magnesium chloride are formed. The first forms a hard scale while the latter is corrosive.

Magnesium Chloride, $MgCl_2$, is the destructive corrosive compound found in sea water. It is very soluble and pits or grooves the interior of the boiler. It is generally supposed to break up under heat and pressure, releasing the chlorine which forms hydrochloric acid.

Sodium Chloride, NaCl, is common salt. It is easily soluble and causes priming, but is non corrosive. It must be removed from the boiler by blowing off, since when present in large quantities it causes priming. The nitrates of sodium, calcium and magnesium are seldom found in appreciable quantities in water. Oxides of iron and aluminum as well as silica are usually considered to be present in a colloidal state. These substances ordinarily occur in very small quantities.

Iron and Aluminum Sulphates, $Fe(SO_4)_3$ and $Al_2(SO_4)_3$, are known by their trade names, copperas and alum. Their action is similar to sulphuric acid.

Bicarbonate of Iron, $Fe(HCO_3)_2$, forms a hard scale when heated and reduced to the carbonate.

Alumina, Al_2O_3, is soluble in water and does not form scale unless acids are present.

Oxide of Iron, Fe_2O_3, is insoluble in water.

Sulphuric Acid, H_2SO_4, is seldom found except around mines and sulphur deposits. With the steel of the boiler it forms $FeSO_4$, resulting in continuous pitting action.

Hydrogen Sulphide, H_2S, is seldom found and readily breaks up into its two elements.

Sodium Carbonate (Na_2CO_3) causes priming and incidentally foaming when present in excessively large quantities. The latter action is caused by disintegrating other "scale forming" matter usually present with sodium carbonate. Sodium bi-carbonate usually accompanies the normal carbonate. The heat of the boiler will break up both of these carbonates, although, of course, the bi-carbonate is the less stable. The carbon dioxide (CO_2) thus driven off gives rise to corrosion above the water line, and is especially destructive in steam lines of stationary power plants. See Table III for chemical treatment. Sodium carbonate, in the form of soda ash, is generally used for the removal of "permanent hardness," such as sulphates and chlorides.

From the viewpoint of the boiler, the two most important things to be considered in connection with the use of water are corrosion and scale. Pure distilled water corrodes a boiler as badly as some impurities.

A good deal of mystery used to surround the question of corrosion. The numerous schemes to prevent it were only partially successful as they were founded on hit and miss methods. The older idea of oxidation has given place in the last few years to the electrolitic theory. Electric current passes from the higher potential to the lower when two different elements come in contact. The effect depends of course upon the substance. The following, taken from a series of tests made under government supervision, is the latest authoritative statement on the subject.*

"From practical experience, study and much experimental work, the writer's conception of corrosion is as follows:

1. All metals dissolve in water or in water solutions if the electric potential of the metal at any point is higher than that of the water or solution.

2. Corrosive products or rust result from the oxidation of the dissolved particles of metal held in solution.

3. The solution pressure of a metal in any liquid is the increase in electrical potential of the metal over that of the liquid.

4. If the potential of the metal in contact with water is higher all over its surface than that of the water, it will corrode evenly or nearly so. If the potential of only one point in the surface of the metal is higher than that of the water, it will pit or corrode locally at that spot. Metals do not pit or groove noticeably in distilled water, acid solutions, or when in contact with a metal of lower electrical potential in water.

5. Local corrosion on bare iron or steel only takes place in water the potential of which has been raised until it is higher than that of certain areas of the metal.

6. Oxygen and carbonic acid do not cause corrosion. If the metal can dissolve they do increase its rate by removing the particles of it from the liquid and thereby preventing an increase in the potential of the liquid.

7. When iron is placed in perfectly pure water into which no oxygen can dissolve, the iron first tends to dissolve, due to its higher potential. Each particle of iron dissolved raises the potential of the water and exposes a new particle of iron. Eventually the potential of the water will be equal to that of the metal at every point, dissolving will stop, and the solution will be saturated. Now if oxygen is present in the water, as the iron is dissolved it will be oxidized, and the potential of the liquid will be raised only to the point where there is equilibrium between the rate of solution of the iron and that of the oxygen, and corrosion of the iron will continue.

8. Metals corrode in sea water at a greater rate than in distilled water due to the higher conductivity of the former. The metal particles get away from the metal and in contact with oxygen or CO_2 more freely and the potential of the water is kept from rising. The natural potential of sea water is not raised to any appreciable extent by the metallic salts it contains, because the high potential metals of these salts are mostly combined with strong acid radicals such as chlorides and sulphates.

9. Hydrogen and all elements lower in the electromotive series than hydrogen, decrease the potential of water in which they are in solution. All elements electropositive to hydrogen increase the potential of the water when they are in solution.

10. The alkalies are the highest in the electromotive series, and are therefore the most soluble in water. They raise the potential of water in which they are in solution.

11. The sodium salts of weak acids increase the potential of water at a greater rate than do the same salts of strong acids.

12. The potential of a solution containing a metal higher in the electromotive series than another metal immersed in it, will

* "The Corrosion of Boilers and Piping on Shipboard," by Commander Frank Lyon, U. S. N. Journal of American Society of Naval Engineers, 1912.

LIME AS A REAGENT

Calcium Bi-Carbonate + Lime = Calcium Carbonate + Water
$Ca(HCO_3)_2 + Ca(OH)_2 = 2\,CaCO_3 + 2\,H_2O$
162 + 74 = 200 + 36
Soluble * Soluble Insoluble

Magnesium Bi-Carbonate + Lime = Mg. Hydrate + Calcium Carbonate + Water
$Mg(HCO_3)_2 + Ca(OH)_2 = Mg(OH)_2 + 2\,CaCO_3 + 2H_2O$
196.9 + 148 = 58.4 + 200 + 36
Soluble * Soluble insoluble Insoluble

Carbonic Acid + Lime = Calcium Carbonate + Water
$H_2CO_3 + Ca(OH)_2 = CaCO_3 + 2\,H_2O$
62 + 74 = 100 + 36
Soluble Soluble Insoluble

Sulphuric Acid + Lime = Calcium Sulphate + Water
$H_2SO_4 + Ca(OH)_2 = CaSO_4 + 2\,H_2O$
98 + 74 = 136 + 36
Soluble * Soluble Soluble (Cold)

Bi-Carbonate of Iron + Lime = Calcium Carb + Iron Hydrate + Water
$Fe(HCO_3)_2 + 2\,Ca(OH)_2 = 2\,CaCO_3 + Fe(OH)_2 + 2\,H_2O$
178 + 148 = 200 + 90 + 36
Soluble * Soluble Insoluble Insoluble

Hydrogen Sulphide + Lime = Calcium Sulphide + Water
$H_2S + Ca(OH)_2 = CaS + 2\,H_2O$
34 + 74 = 72 + 36
Soluble Soluble Slightly Soluble

Soduim Carbonate + Lime = Calcium Carbonate + Soduim Hydrate
$Na_2CO_3 + Ca(OH)_2 = CaCO_3 + 2\,NaOH$
106 74 100 80
Soluble Soluble Insoluble Soluble

Caustic Soda + Calcium Bi-Carbonate† = Sodium Carbonate + Calcium Carbonate + Water
$2\,NaOH + Ca(HCO_3)_2 = Na_2CO_3 + CaCO_3 + 2H_2O$
80 162 106 100 36
Soluble Soluble Soluble Insoluble

* Lime is only partially soluble. The lower the temperature the greater the solubility. † Magnesium Carbonate, $MgCO_3$ gives a similar reaction

SODA ASH AS A REAGENT

Sulphate of Lime + Soda Ash = Calcium Carbonate + Sodium Sulphate
$CaSO_4 + Na_2CO_3 = CaCO_3 + Na_2SO_4$
136 + 106 100 142
Soluble Soluble Insoluble Soluble

Mg. Sulphate + Soda Ash + Lime = Mg. Hydrate + Sodium Sulphate + Cal. Carbonate
$MgSO_4 + Na_2CO_3 + Ca(OH)_2 = Mg(OH)_2 + Na_2SO_4 + CaCO_3$
120.4 + 106 + 74 = 58.4 + 142 + 100
Soluble Soluble Soluble Insoluble Soluble Insoluble

SODA ASH AS A REAGENT (Continued)

Chloride of Lime + Soda Ash = Calcium Carbonate + Sodium Chloride
$CaCl_2 + Na_2CO_3 = CaCO_3 + 2\,NaCl$
111 + 106 = 100 + 117
Soluble Soluble Insoluble Soluble

(Heating Aids in Above)

Chloride of Mg. + Soda Ash + Lime = Mg. Hydrate + Sodium Chloride + Cal. Carbonate
$MgCl_2 + Na_2CO_3 + Ca(OH)_2 = Mg(OH)_2 + 2\,NaCl + CaCO_3$
95.4 + 106 + 74 = 58.4 + 117 + 100
Soluble Soluble Soluble Insoluble Soluble Insoluble

Nitrate of Lime + Soda Ash = Calcium Carbonate + Sodium Nitrate
$Ca(NO_3)_2 + Na_2CO_3 = CaCO_3 + 2\,NaNO_3$
163.86 + 106 = 100 + 169.86
Soluble Soluble Insoluble Soluble

BARIUM HYDRATE AS A REAGENT

Calcium Sulphate + Barium Hydrate = Calcium Hydrate + Barium Sulphate
$CaSO_4 + Ba(OH)_2 = Ca(OH)_2 + BaSO_4$
136 + 171 = 74 + 233
Soluble Soluble Slightly Soluble Insoluble

Magnesium Sulphate + Barium Hydrate = Magnesium Hydrate + Barium Sulphate
$MgSO_4 + Ba(OH)_2 = Mg(OH)_2 + BaSO_4$
120.4 + 171 = 58.4 + 233
Soluble Soluble Insoluble Insoluble

SILICATE OF SODA AS A REAGENT

Silicate of Soda + Calcium Bi-Carb. = Sil. of Cal. + Sodium Carb. + Carb. Diox. + Water
$Si\,O_3\,Na_2 + Ca(HCO_3)_2 = CaSi\,O_3 + Na_2CO_3 + CO_2 + H_2O$
122.2 + 162 = 116.2 + 106 + 44 + 18
Soluble Soluble Insoluble Soluble Soluble

Silicate of Soda + Calcium Sulphate = Sodium Sulphate + Calcium Silicate
$Si\,O_3\,Na_2 + CaSO_4 = Na_2SO_4 + Si\,O_3\,Ca$
122.2 + 136 = 142 + 116.2
Soluble Soluble Soluble Insoluble

MAGNESIA AS A REAGENT

Calcium Bi-Carbonate + Mag. Hydrate = Calcium Carbonate + Mg. Carb. + Water
$Ca(HCO_3)_2 + Mg(OH)_2 = CaCO_3 + MgCO_3 + 2H_2O$
162 + 58.4 = 100 + 84.4 + 36
Soluble Insoluble Insoluble Insoluble

Mag. Bi-Carbonate + Mag. Hydrate = Magnesium Carbonate + Water
$Mg(HCO_3)_2 + Mg(OH)_2 = 2\,MgCO_3 + 2\,H_2O$
146.4 + 58.4 = 168.8 + 36
Soluble Insoluble Insoluble

BARIUM CARBONATE AS A REAGENT

Calcium Sulphate‡ + Barium Carbonate = Barium Sulphate + Calcium Carbonate
$CaSO_4 + BaCO_3 = BaSO_4 + CaCO_3$
136 197 233 100
Soluble Soluble Insoluble Insoluble

‡ Magnesium Sulphate, $MgSO_4$, gives a similar reaction

Table III. Action of Various Reagents on Dissolved Substances.

increase faster with a rise in temperature than that of the immersed metal.

13. When boiler water is properly treated, air, copper, graphite, zinc oxide and other electronegative metals in contact with iron or steel have no effect whatsoever in starting and maintaining corrosion, but they do have a very serious effect if the water is not properly treated, and their effect increases with the perfection of their metallic contact with the metal of the boiler.

These tests also showed a fact that is contrary to the popular ideas of the subject. 'No concentration that has been found to be non corrosive to iron or steel at room temperatures has ever been found corrosive at temperatures up to 420° F., that corresponding to a steam pressure of 300 pounds gage. It has been found that concentrations just below the upper limit, and therefore corrosive, were non corrosive to the same steel at higher temperatures. It must be that with rise in temperature the potential of the solution rises faster than that of the metal.'

The conclusion of the whole matter is as follows: 'The writer has no hesitancy in saying that *any boiler using any water can be kept from corroding for any length of time, if treated with soda, and if its concentration is maintained at or above 3 percent. normal alkaline strength. If the water is not to be kept sufficiently alkaline, it had better be kept neutral.*' ''

The above method has been extensively used and is now standard practice on the ships of the Navy, but has apparently not been tried to any extent on shore. The lime and soda ash treatment has frequently accomplished the same result, incidentally, due to furnishing a slight excess beyond the theoretical requirements of reagents necessary to effect a proper reduction in the hardness.

Books on boiler operation give analyses of a great variety of boiler scales. In the foregoing the chemicals which may be found in scale have been given. The division of scale into hard and soft is practically as good as any other. The scale ordinarily found may be divided roughly into these two classes.

Scale increases the cost of boiler operation in several ways, by (1) Insulating the tubes and sheets so that part of the heat is not transmitted to the water; (2) Causing overheating of tubes and sheets. The crown sheet usually suffers the most from this cause; the sheet being in direct contact with the flames, the temperature rises to the point at which the scale will transmit the heat to the water; (3) Causing boiler explosions; there are cases in which the scale has cracked suddenly, allowing the water to come in contact with the super-heated plate, causing the generation of a large amount of steam and exploding the boiler; (4) Causing shut-downs for cleaning or repairs; (5) Causing loss of heat and water through blowing-down to remove soft mud.

The expense of removing boiler scale by mechanical means is frequently very great, as some of the worst places for scale to accumulate are not readily reached. The use of water treated with lime and soda ash in an ordinary softener, will cause a great deal of scale to detach itself. It can then be readily removed.

Treating water, in order to precipitate the deleterious substances found in solution, usually is attempted by one of two methods. The treatment may be done, after a fashion, in the boiler by the use of boiler compounds. The better method is to treat the water before it goes into the boiler.

There are a great many boiler compounds now on the market and new ones appear now and then. After listening to the salesmen handling them one wonders that anybody ever had any trouble with water. One agent makes the claim that his compound changes the shape of the molecule from the hook-shaped to the spherical. The spherical being round cannot stick to a plane surface and form scale. Another tells a wierd tale of how the substance, when it comes in contact with hot metal expands and rebounds. Apparently it is expected to bounce afound like a rubber balloon. The literature on the subject is very scarce and the following is largely taken from a government report on the subject.*

"The perfect boiler compound must fulfill the following requirements: (a) It must render the water in the boiler non corrosive at any temperature to which it may be subjected; (b) It must hold in suspension, or preserve in the colloidal form, all of the salts in the water that would otherwise be precipitated as a scale, whether such precipitation be by the action of heat or by that of any of the chemicals used in the compound; (c) It must render the treated water no more liable to foam or prime than distilled water under the same conditions; (d) It must be composed of chemicals that are safe to store, that do not deteriorate materially with age, and that are non-explosive and non-inflammable; in other words, the compound must be such that it requires no particular care in stowing or handling; (e) Some one constituent must be such that its strength in the water (its concentration) can be easily measured by some simple chemical measuring device."

The following tests should be made to form an idea of the merits of the compound: (A) Chemical; (B) Corrosion; (C) Scale removal; (D) Priming.

A test of this nature will take time but when once made the substance can be handled intelligently by any one capable of taking care of a boiler. When contemplating the use of a compound, the man in charge of a boiler must first understand the nature of the treatment, the results to be obtained, and the work of the fireman in connection therewith.

Examination of the records in the Patent office show that there are compounds guaranteed to remove boiler scale of which hydrochloric acid is the base. It will remove the scale and boiler also in time. In fact the more scale there is the safer the process. Graphite is frequently used also. It removes scale for the same reason that hydrochloric acid does. It corrodes the boiler underneath the scale and aids in its removal by forming "rust."

The treatment of the feed water before it goes into the heater or boiler is the most satisfactory process. It attracted the attention of chemists three-quarters of a century ago, and in 1841 Dr. Clark of Aberdeen, Scotland, found that the carbonates usually present in well or surface water would be precipitated by the addition of hydrate of lime. Later Dr. Porter discovered that the sulphate of calcium, which is probably the most serious scale forming substance commonly found, could be precipitated by the addition of caustic soda or soda ash. Since their time, these substances have been used as reagents principally on account of their cheapness. There are other efficacious methods but they cannot compete in cost. The early softeners were simply large tanks in which the reagent was placed with the water to be treated. The mixture was stirred by mechanical means and allowed to stand until the water was clear. This is practically what we now call the intermittent process, although air is used as a mechanical mixer, to stir the solution. Some chemists prefer the intermittent type as they claim they get a more uniform mixture and know exactly what proportion the chemicals bear to the impurities in the raw water. Where the treating tubs can be placed at an elevation so that the water will not require repumping, but flows direct to the storage tank or point of use, it has some advantages.

Inventors at an early date undertook to make the mixture as the water was pumped into the softener. This type has been called the "continuous." One of the earliest perfected was the Stingl in Germany. The subject of the continuous softener began to attract attention in America about the beginning of the present century and the industry has made great strides since that time.

The continuous type has been preferred both in Europe and America on account of its being a "going concern."

The modern type usually consists of a softening or reaction chamber and a settling tank wherein the soft water deposits the hardness which has been precipitated in the softening chamber. The purified water is then discharged into a storage tank. The sludge is ordinarily removed to a convenient sewer or sump by opening valves located in the bottom of the settling tank.

The diagram, Figure 1, shows all the essential features of a continuous plant. Chemical solutions are prepared at the foot of softener, pumped to the top and proportioned by weirs and deliv-

* "Boiler Compounds"—Commander Frank Lyon, U. S. N. Journal American Soc. Naval Engineers, 1912.

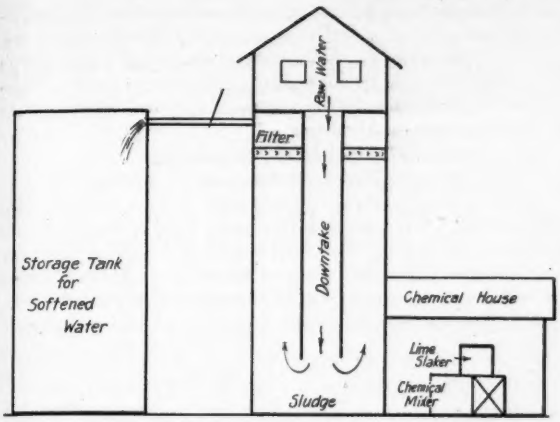

Fig. 1.

ered at top of downtake with the raw water. In others the proportioning is done by weirs at the bottom in the chemical house. Some have agitators in the downtake and some do not. Filters are in practically all, except a new type recently installed. Notwithstanding the apparent simplicity of the problem, there are a large number of builders of these machines. The proportioning devices are usually patented and constitute the principal difference. In the United States there are a number of well known makes. In Europe the first continuous softener placed in commission was known as the Beranger and Stingl. It was built in 1874. Stingl is usually credited by continental chemists with having been the inventor of the soda ash process. A few of the other well known makes are: Deeley, Criton, Guttman, Desrumeaux, Wehrenfennig, Reisert, Brunn-Loewener, etc., etc.*

The aim in the majority of these machines is to have the flow of water proportion and mix the chemicals and furnish the power for the chemical tank agitator. The mixing of the raw water and reagents is usually accomplished by numerous baffle plates. These machines work very well in the hands of skilled attendants, but must be run with great exactness and care.

In the multiplicity of details, one is apt to lose sight of the fundamental principles involved. The best type of machine in the opinion of the writer (there are several makes) should have the following characteristics:

(1) Power should be furnished by an overshot wheel on top of softener. It is positive in action, its speed is proportional to the flow and it will not have difficulty in handling water containing grit, etc.

(2) The chemical tanks for reagent should be on the ground. They should be of ample size in order that the solution (particularly of lime) will not be too strong. A concentrated mixture will require excessive mixing and cause trouble with chemical pumps.

(3) The proportioning should be done by weir measurement, trip bucket or weighing device.

(4) The chemicals should be introduced at the top of the downtake and not under pressure at the bottom.

There should be thorough mechanical mixing of the chemicals and raw water in the downtake in order to hasten the precipitation. In some of the schemes the flow of the water and the consequent intermingling is relied on to do this.

Wehrenfennig gives the following tabulation on the progress of softening:

Period of clarification in hours	—1—		—2—		—3—		—6—		—10—	
	H.	A.	H.	A.	H.	A.	H.	A.	H.	A.
Addition of reagents according to calculation.	12.0°	4.2	9.3°	3.4	6.7°	2.7	6.5°	2.7	6.5°	2.65
	22.5°	6.5	12.8°	4.5	10.7°	4.1	8.9°	3.8	8.5°	3.0

H—Hardness in German degrees.
A—Alkalinity.

It will be seen that it takes ten hours for part of the scale forming chemicals to precipitate. By the mechanical mixing of the water in the downtake the chemical reactions and settling are hastened. This seems to be on the principle of the snow ball. These particles adhere when brought in contact and form large flakes which settle rapidly. The following experiment shows this very clearly. (See Figure 2 and Figure 3.)

* "L'eau dans l'industrie," par H. de la Coux.
"Uber das Untersuchung und das Weismachen des Kesselspeiswassers," von E. Wehrenfennig.

The water selected for the experiment contained a hardness of 16.6 and alkalinity of 13.7 both in grains per U. S. gallon. The chemicals added were identical in each case. The reagents used were 90% lime equivalent to 1.9 pounds per 1,000 gallons, and 58% soda ash equivalent to 1.2 pounds per 1,000 gallons.

The photograph, Figure 2, was taken three minutes after the chemicals had been added. In the unstirred experiment (2b) the chemicals were mixed with the water by eight revolutions of the agitator. The stirred sample (2a) was subjected to agitation by the agitator at 24 or 25 revolutions per minute, corresponding to about 10 feet per minute for the three minute period.

Figure 3 was taken 6 minutes after the experiment was begun. The agitation of the sample (a) had ceased just prior to taking

Fig. 2a Fig. 2b
Showing Difference in Settlement of Sludge at the End of Three Minutes.

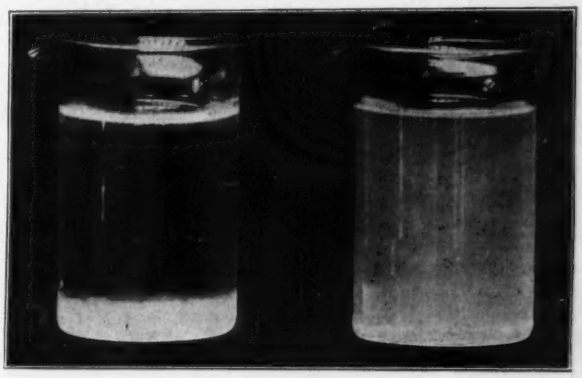

Fig. 3a Fig. 3b
Showing Difference in Settlement of Sludge After Six Minutes.

(2a) so that (3a) represents the result of three minutes' agitation plus three minutes' quiescent subsidence.

The latter picture shows that practically no sedimentation had taken place in (3b) which was not sufficiently agitated, while in (3a) the precipitate had practically settled out.

This question of the rapidity of reaction and settling has a very important bearing upon the proportioning of water-softeners for railroads. Generally, there is a storage tank in the ground before a softener is proposed. This tank is frequently over 60 feet in height. The softener will have to be higher than the storage tank, say 66 feet for example. Then the start is made with the statement that the softener shall have 6 hours capacity. In the above case this would mean that the rate of upflow would be over 10 feet per hour. With ordinary waters the rate of sedimentation (particularly when water contains magnesia) will be less than the rate of upflow and the sludge will be carried upward and must be removed by a filter. This filter must be frequently cleaned and will not remove all the precipitate at the best. When this is true, secondary sedimentation will take place in the storage tank and frequently milky water passes over into the tender. The cost of removing an old high tank and putting at a new site should be

considered in connection with a softener which is low and broad. Figures 4 and 5 show a softener erected by the L. M. Booth Co., for the Rock Island Lines at Burr Oak, Ill., in which the rate of upflow has been reduced to a minimum. This softener has a capacity of 50,000 gallons per hour and supplies a round house, switch and road engines. At the beginning of work in the morning and at noon the draft is very heavy and large storage capacity is required. The standpipe at the right of the picture carries a head of 80 feet. The softener provides a storage capacity of 308,000 gallons of softened water. There is an overshot wheel which provides power for the agitator in the downtake and for the pump and agitator in the chemical house at the foot of the tank.

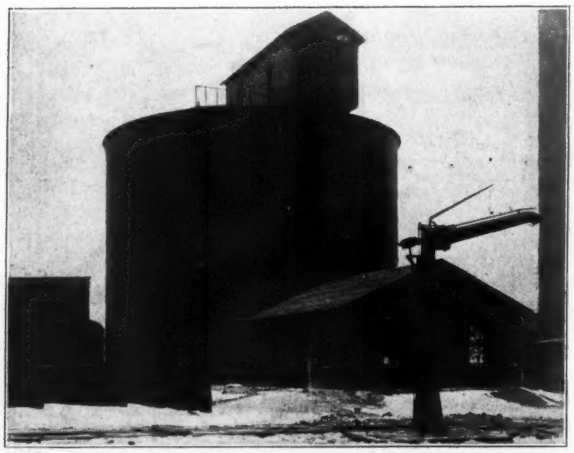

Fig. 4. Burr Oak Combination Softener and Storage Plant.

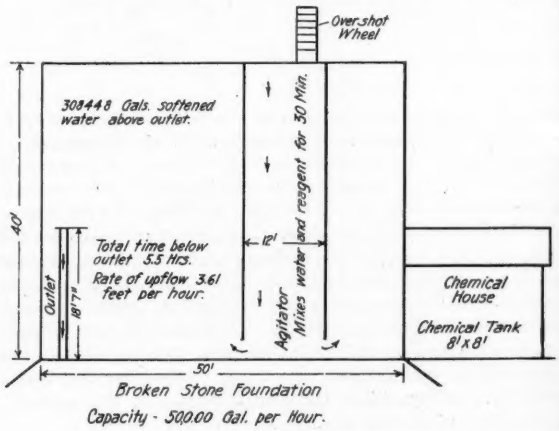

Fig. 5.

The purifying chemicals, lime and soda, are prepared in the chemical house. The regulator which proportions the flow of chemicals is also at ground level.

The reagents which have been used at different places are shown in Table III. Lime and soda ash being the cheapest are the ones oftenest used. But soda ash leaves soluble salts in the solution which cause foaming if present in large quantities. The amount of foaming salts that a locomotive boiler can take care of without trouble varies from 100 to 200 grains per gallon. The question of whether foaming will take place or not depends upon the shape of the boiler and the amount of matter in suspension.

If all the water stations on an engine district furnish softened water, the water may be more completely treated; that is, softened to a lower degree, than if the locomotives take a portion of their supply from raw water sources. A completely softened water, one in which sufficient soda has been used to reduce the hardness to the minimum, has a tendency to disintegrate scale deposited from hard water. This finely divided old scale is responsible for the foaming which occurs shortly after the introduction of softened water to boilers which were not free from sediment.

Torpedo boats and similar crafts have boilers which can use sea water without trouble. The locomotive boiler is jarred and shaken to such an extent that it is one of the worst subjects possible in this respect. The salts of barium would be very useful in water softening but as they are poisonous the trainmen might be affected by them, as they drink a good deal of the water. The barium and silica compounds are produced in the electric furnace and will probably be cheaper in the future than at present.

In Table III, the molecular weights of the different chemicals are given for convenience in computation. A solution containing 162 grains of calcium bicarbonate by the addition of 74 grains of lime would have as a precipitate 200 grains of calcium carbonate and water. These refer to pure chemicals. When bought commercially the basis should be the net weight of pure chemicals and not the gross weight.

In computations the amount of scale removed, in pounds, is frequently used as a unit. It is generally safe to assume that the grains per gallon of incrustants will be reduced to 5. If you have a 26 grain water, by analysis, 21 grains will be removed. The number of grains removed per gallon divided by 7 will give the number of pounds per 1,000 gals.

$21/7 = 3$ lbs. incrusting matter removed.

or $21 \times 1{,}000 = 21{,}000$ grains removed.

$21{,}000 \div 7{,}000$ (grains per pound) $= 3$.

Whether or not it pays to soften water on a railroad has been debated in a good many ways. As a general proposition there can be no doubt of it, but just where the dividing line between waters that will justify treatment and those which will not, is not so certain. It depends upon the amount of water used rather than upon the hardness of any particular water. With water containing calcium sulphate in such amount that it produces foaming when treated, it might not pay if only one point on an engine district is equipped with a softener, while the reverse would be true if all points were affected. To get the full benefit, each point on a district should have softened water. Railroads do not keep the costs of boiler repairs in such a fashion that the amount of money expended due to impure water can be segregated.

A method of computing the value of a softening plant is briefly as follows:

Z = number of pounds incrusting solids, in thousands, removed per annum.

A = additional cost of water service in units of 1,000 lbs. of solids removed, (1) wages, (2) repairs, (3) chemicals, (4) additional power at water station, (5) light, heat, etc., (6) cost of water and heat lost when treated water required blowing out.

B = money saved by the removal of 1,000 lbs. of solids; (1) boiler washing, (2) repairs, (3) fuel, (4) increased locomotive performance. Additional miles service which would be had if locomotive is not in shop undergoing repairs to boiler.

I = interest per annum on softening plant.

C = cost of said plant.

L = estimated life of plant.

S = salvage at end of that period.

D = depreciation per year. That is, a sum per year which, if placed in a sinking fund at I rate of interest, will equal C—S in L years.

Savings and outlay would balance when

$A\,Z = B\,Z + I + D$.

The number of pounds, in thousands, which must be removed each day in order that the savings and cost will just balance will be:

$$\frac{I + D}{0.365\,(A - B)}$$

The mechanical department of each railway should be able to furnish the data for A, when the quality of the water is given.

CONCRETE DEPARTMENT

Reinforced Concrete Fences.

REINFORCED concrete slab fences are being used extensively by many railroads and private corporations to take the place of ordinary board fences and those of brick or costly ornamental iron construction, and it should therefore be of more than passing interest to engineers to have definite data regarding details of design, construction and cost of such structures placed at their disposal. Heretofore the data available on such structures have been more or less fragmentary and therefore of little value. For this reason we feel particularly fortunate in being able to present our readers with the complete history of the development of such fences as used by the Long Island R. R.; with the lessons learned by experience with various types, together with the details of design and costs thereof.

At first thought the cost of reinforced concrete fences is generally considered prohibitive except for ornamental purposes where cost is a secondary consideration. A study of the subject, however, will reveal the fact that by the use of standard units so designed as to readily fit almost any condition the cost can be materially cut down. As in many other classes of concrete work, the secret of the cost lies in the type of forms used. on account of the great amount of form surface required for a relatively small amount of concrete. As has been the experience of the Long Island R. R., the solution lies in the use of standard premolded units, the molding of which requires one less side form than for slabs molded in place.

The Effect of Salts Upon Concrete

ON another page in this issue appears an abstract of an article on "The Effects of Salts Upon the Strength of Concrete," which should prove of interest to the engineer. A few years ago the use of common salt for lowering the freezing point of concrete mixtures so as to allow of concreting during weather just below the freezing point, was quite common. Nowadays, however, with the increased amount of winter concrete work other methods, such as heating the materials in various ways, are being used in practically all cases, to the exclusion of sodium chloride and calcium chloride in the mixing water, which have not always given satisfactory results.

The tests cited prove conclusively that the addition of salts to the mixing water does not produce concrete, when cured under low temperatures (0° to 30° F.), with strength anywhere near equal to that of concrete cured under normal conditions. The fact that the addition of common salt to concrete mixtures cured in ordinary room temperatures materially lowered the strength of same would seem to indicate that if the concrete materials are heated and the concrete protected until final set, the addition of salt can be only detrimental to the strength of the concrete.

There can be no doubt then, that much better results can be obtained by heating the materials and protecting the concrete, after pouring, from freezing until after it has attained its final set. The use of salts as a precaution against freezing is simple and cheap for small work if unreinforced, but in work of any magnitude the benefits derived are of a doubtful nature.

Salts should not be used in concrete where a good surface is required, for efflorescence is very likely to take place, which will disfigure the surface. Again, if there is any danger of electrolytic action in the concrete, salt should be avoided, for it makes the concrete more susceptible to such action. Mr. Clifton P. Mayfield of the Engineering Department of the Pennsylvania R. R. found that the presence of salts caused corrosion of reinforcement, which was greater on the under side of the bar and also in concrete placed as a dry or lean mixture. He also found that the corrosion increased with an increase in percentage of salt used and that calcium chloride caused a greater action than common salt. With these facts in mind, it does not seem advisable to use salts to prevent the freezing of concrete.

In regard to the tests made at the University of Wisconsin, it might be said that more conclusive results would have been attained as to the effect of the use of salts on the strength of concrete cured at low temperatures if the final specimens had been tested during the summer after they had passed through a period of warm weather. This would have given conditions more nearly parallel to those actually obtained in commercial work.

METHODS OF SURFACE FINISH USED ON TRACK ELEVATION STRUCTURES N. Y., C. & ST. L. R. R., CLEVELAND, OHIO.*

Great pains were taken to remove all form marks and other defects from the surfaces of the masonry. The cheapest method and one that proved generally pleasing was to brush-hammer the surfaces. Such work was done at a cost of 4 cents per sq. ft. Other surfaces were rubbed smooth with carborundum bricks at a cost varying from 4 cents to 10 cents per sq. ft. No concrete surface can be made to retain a good appearance unless all laitance be thoroughly removed. Its deposition on the surface may be prevented by proper care in filling the forms, that is by drawing off the surplus water from the concrete at the rear of the masonry.

Little difficulty was experienced in making repairs or correcting defects. Surfaces to be patched were carefully cleaned and then soaked with water. The mortar was applied in comparatively thin layers by throwing on forcibly with a trowel, each layer being permitted in turn to harden. Such work has gone through three winters without sign of failure.

Iron trowels were never used in finishing the surface. Very smooth surfaces were obtained with carborundum. Rough, sandy surfaces, resembling Cleveland sandstone, were secured by rubbing with wooden floats while the concrete was still green. This is an excellent finish and can be done at a cost less than bush-hammering if there are no surface defects to be removed.

When the aggregate was desired to show, the mortar was brushed away while green with wire brushes, a good finish of the latter sort requires the aggregate to be uniform in size and uniformly placed and is therefore not easy to secure.

A very beautiful surface can be obtained by bush-hammering a concrete made with quartz gravel.

While building the First National Bank building at Bandon, Oregon, a hill with steep slopes which adjoined the property was used to aid the distribution of concrete. The mixing plant was placed at the top of the hill and the concrete for the entire building distributed through a trough chute.

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*Abstract from paper by A. J. Himes, Engineer of Grade Elimination, in Bulletin No. 160 Amer. Ry. Eng. Assoc.

REINFORCED CONCRETE FENCES. LONG ISLAND R. R.*

By A. M. Wolf, C. E.

General.

The increasing use of concrete in nearly all kinds of construction has brought about a considerable development in the design of reinforced concrete fences to replace those of wood or iron. Where a solid fence is required, one of concrete is much more permanent and, therefore, in the long run, cheaper than one of wood. As to strength and appearance the concrete fence can be made to excel by far, a fence of wood. As will be noted from the illustrations presented herewith, concrete fences can be made very pleasing in appearance by a relatively simple treatment. If a considerable amount of fencing is to be done the use of unit forms, used over and over, will make the concrete fence cheaper than one of brick. This has been the experience on the Long Island R. R.

This company during the past ten years has built a large amount of concrete fencing, which in general has given satisfactory service. The earliest of these structures was erected around a freight yard, the intention being to provide a solid screen which would be more permanent than the ordinary board fence. The types here described indicate the evolution of the practice of this road during the past seven years.

Details of Design—Type A.

The first design (Type A, see Figures 1 and 2) was for a 3-inch slab with anchorage ribs on the back. This type was premolded and set on top of a retaining wall with dowels front and back for the anchorage, these dowels extending up into the space between the ribs, which was then grouted full.

The sections of fence were made 4 feet 11 inches long, designed to have a joint 1 inch wide between sections, each one, therefore, making a five-foot section. The sections were 4 feet 6 inches high, with buttress ribs 2 feet high at each end. A bearing of 8 inches for the slab proper was provided at the ends of each section, the portion between being raised 1 inch above the top of wall to avoid trouble which might be caused by freezing of seepage water under the slabs. The slabs 3 inches thick are reinforced with seven ¼-inch square bars 4 feet 2 inches long, spaced 9 inches centers vertically and six ¼-inch horizontal bars 4 feet 8 inches long, 9 inches centers. The face of the slabs are provided with ⅜-inch corrugations, formed by casting the slabs face down on corrugated iron sheeting. The corrugated face was used for a two-fold purpose: (1) to improve the appearance and (2) at the same time prevent children from marking up the surface. At the top of the slab is a beveled coping, details of which are shown in Fig. 1. In order to readily raise the slabs into place after curing, $\frac{7}{16}$-inch hoops 3 feet 6 inches long were cast in the slab at the middle portion, with the top of hoops 12 inches below top of rail.

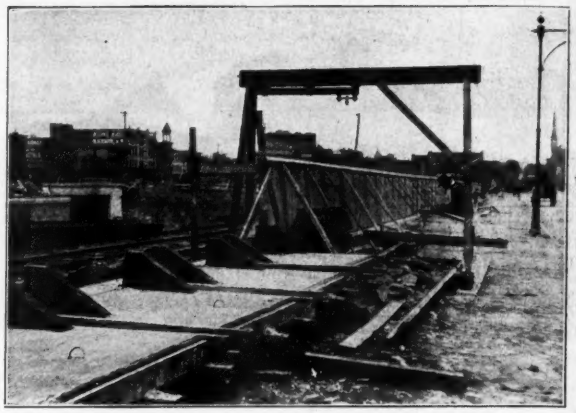


Fig. 2. Construction View Ribbed Fence, Type "A," L. I. R. R.

The buttress ribs at the back, for supporting the units, are 3¾ inches thick at the junction with slab and 3 inches thick at the end 1 foot 2 inches from face of slab, and are reinforced with a ⅜-inch bar bent as shown in Fig. 1. Besides the dowels in wall extending up between fence sections, as previously mentioned, the units are tied together horizontally by four ½-inch bars 6 inches long grouted into 2-inch diameter core holes near the bottom of buttress ribs.

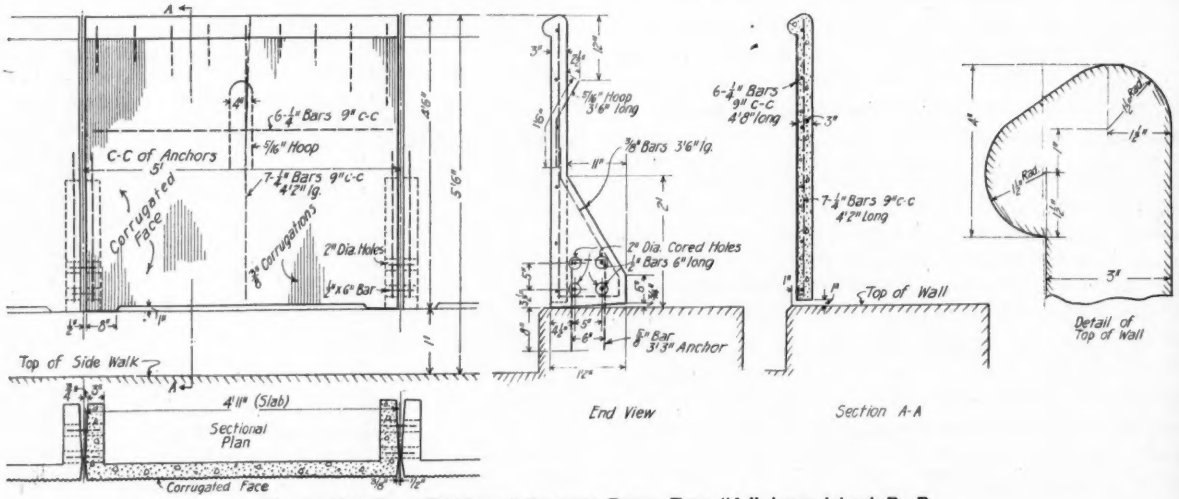


Fig. 1. Details of Reinforced Concrete Fence, Type "A," Long Island R. R.

Construction and Cost—Type A. Fig. 2 shows some of the fence units cast in the molds, face down, ready to be raised into position with the aid of the hoisting frame shown in the illustration. After erection the sections were grouted together and securely shored to keep them in line while the grout hardened. The concrete used in this fence was a 1:2:3 mixture with gravel as the coarse aggregate.

The cost of this ribbed fence was $2.50 per foot erected.

Type B—Details of Design.

The second contract let, for concrete fence construction at the Vanderbilt Ave. Yards, was of a different type ("B"), since the contractor considered it cheaper to set up the forms and cast the slabs in place, instead of casting them on the ground and erecting later. It was decided that the fence would look much better if broken up into panels and 7-inch square posts were, therefore, used between the panel slabs, at a spacing of 10 ft. centers. The posts were first cast in place with grooves in the sides to receive the ends of the 3-inch panel

* Copyright, 1914, W. E. Magraw.

slabs which were later cast in place. In addition to the grooves round rods were used to bond the posts and the slabs together, the rods being greased to provide for expansion. The panels have a corrugated facing and a rounded coping cast integral with the slab. (See Fig. 3.)

As originally designed this fence was to be built in 5 feet sections with about 2.5 pounds of steel per linear foot of fence. The contractor, however, chose to build the fence in 10-foot sections with about 4 pounds of steel per linear foot.

The slab 4 feet 6 inches high is 3 inches thick and is reinforced with ⅜-inch vertical bars 18 inches centers and one ½-inch square bar in coping and three ⅜-inch square bars 17 inches center to center in the panel. The slabs rest on the retaining wall, to which the posts are doweled, at the ends center for a length of about 6 inches; between these points the slab is raised about 1 inch with the edges beveled, leaving a chamfered opening at the bottom of the slab.

The posts, 7 inches square and 5 feet high, are doweled to the retaining wall by two ¾-inch square dowels 2 feet 4 inches long. The reinforcement of posts consists of four ½-inch square bars, one near each corner. The corners of posts are rounded off to a radius of about 1 inch. (See Fig. 4 for details.)

All surfaces of this fence and posts were smoothed down and painted with La Farge Cement after completion. The cost of the fence of 4 feet 6 inches height was $2.75 per foot and $3.50 for the 6-foot height.

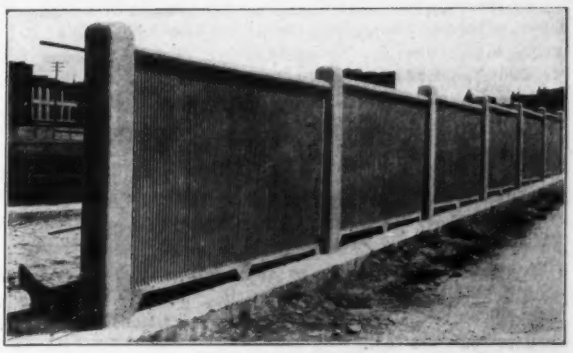


Fig. 3. Detail of Ribbed Concrete Fence, Type "B," L. I. R. R.

of the posts are slotted to a depth of 1 inch to receive the ends of slabs which are beveled off at 2 in 12. The ends of slab panels have a bearing of about 4 inches on the base portion of the posts, while the slab between is raised about an inch above ground with the edges chamfered.

This type of fence when resting on tops of retaining walls is built as indicated in Figure 6. The slab is the same as for fence not on walls except that it has a 6-inch bearing at mid-span and is anchored to the wall at that point. The posts are of the same size but the reinforcing bars are ¼ inch squares

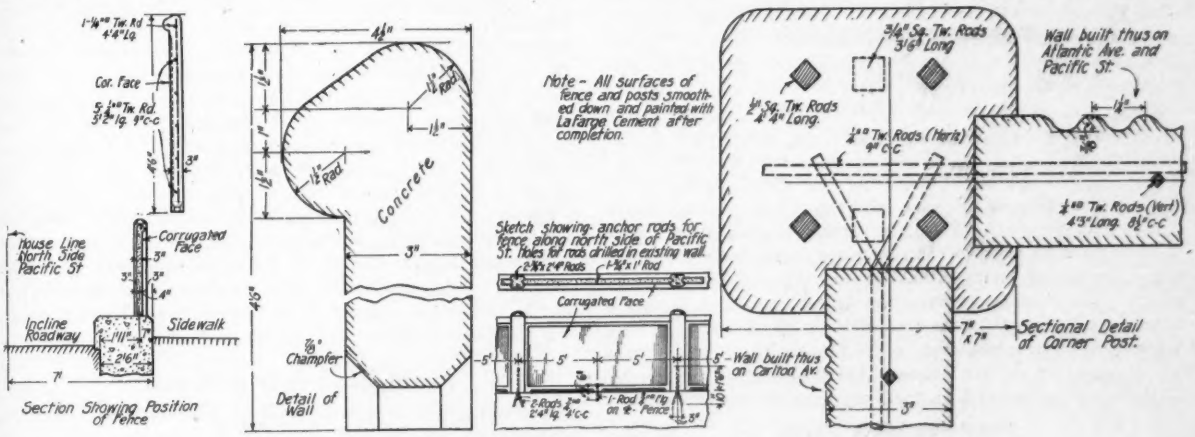

Cor. Face
Corrugated Face
House Line North Side Pacific St
Incline Roadway
Sidewalk
Section Showing Position of Fence
Concrete
Detail of Wall
Note - All surfaces of fence and posts smoothed down and painted with LaFarge Cement after completion.
Sketch showing anchor rods for fence along north side of Pacific St. holes for rods drilled in existing wall.
Wall built thus on Atlantic Ave. and Pacific St.
Wall built thus on Carlton Av.
Sectional Detail of Corner Post.

Fig. 4. Details of Concrete Fence, Type "B," Long Island R. R.

Type B—Recent Design.

In the more recent designs for fences of Type B the corrugated faces have been omitted, this being considered better design in the light of the troubles experienced due to the corrugations. It often happened that the reinforcing rods were slightly misplaced from their central position in the 3-inch slab and as a result have rusted at the bottom of the corrugations where the coating was the thinnest. The rust has then forced off the thin covering in places and the steel is still further exposed to corrosion.

Experience has shown that it is better to premold the posts and slabs, both cast horizontally, which insures proper location of the steel and at the same time renders the construction cheaper since only bottom and side forms are required.

Figure 5 shows the details for the latest type of fence, where posts are set in the ground. This consists essentially of a 3-inch slab 10 feet long and 4 feet high, reinforced with ¼-inch square twisted bars, 9 inches centers, both horizontal and vertical, in middle of slab, and set between reinforced concrete posts. These posts are 7 inches square above ground and 14 inches square below ground for a depth of 3 feet 6 inches. The upper portion, 4 feet 5½ inches high, is reinforced with four ¾-inch square twisted bars and doweled to the lower portion with two ¾-inch bars. The edges of post are rounded, as is the top. The sides instead of ⅞ inch. The posts are doweled to the retaining wall with ¾ inch dowels.

These walls have been built in place as well as premolded, in the former case the posts were cast first and several thicknesses of tar paper placed in the slots before pouring the slab panels, thus forming a positive expansion joint.

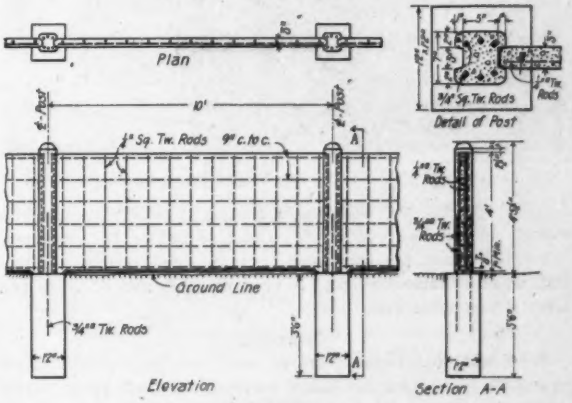


Fig. 5. Latest Type "B," Reinforced Concrete Fence, L. I. R. R.

The fences of Type "B" with plain face, built in place by the company's forces, with panels 10 feet long and 4 feet 6 inches high, have cost about $2.00 per foot. The same type premolded cost $2 per foot by contract, but the actual expense to the contractor was not more than $1.50 per foot.

Type "C."

The fence shown in Figure 7 consists of slabs 9 inches thick, molded in place. The type of fence has no reinforcement whatever and has a separately molded coping which is grouted into place after the slabs have hardened.

This fence is used only as a bridge parapet or on heavy retaining walls to harmonize with the massive construction of the bridge or wall. The cost of this type of unreinforced fence is about $5.00 per foot.

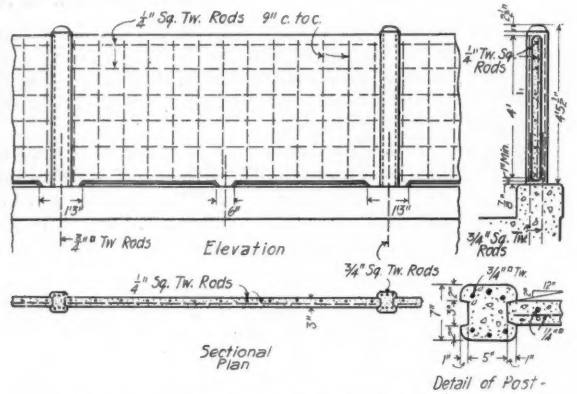


Fig. 6. Type "B" Fence on Walls, L. I. R. R.

Plate Girder Bridge Parapet.

A concrete parapet or fence of massive but pleasing design is shown in Figure 8. This is a through plate girder encased in concrete with massive concrete posts at intervals projecting above the heavy coping which encloses the top flange of the girder. The portion between the bottom rail and coping is paneled as shown, the corrugated effect being produced by placing strips of corrugated iron in the forms. The faces of posts are paneled in a similar manner. The appearance of this piece of work is excellent and, in fact, improves the entire structure.

Surface Finish of Fences.

The general method of surface finish used for concrete fences by the Long Island R. R. is briefly described as follows:

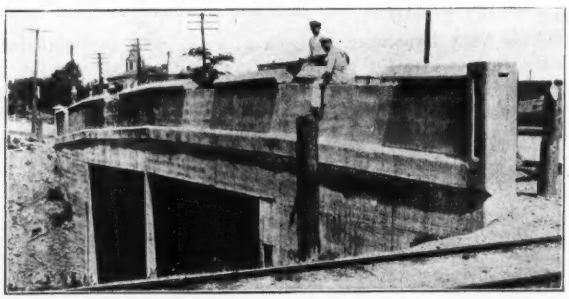


Fig. 7. Type "C" Fence, for Bridge Parapets, L. I. R. R.

Before placing the slab panels the posts, previously cast, are wetted and rubbed with a wire brush to expose the aggregate. When the panels are completed they are rubbed smooth with a thin wash of cement grout. A very pleasing and effective contrast is thus obtained.

Comment.

From what has been described and illustrated herein, it can be readily seen that the Long Island R. R. has made considerable use of concrete as a building material for fences. We doubt if there are any roads that have made a more extensive use of concrete fences or have developed the design to such a high degree with the resulting economy obtained in the later designs made by this road. Concrete fences, on account of their permanent and fireproof character, are deserving of a much greater use and we venture to say that it will not be long before the more conservative railways will use them as standard for a number of purposes.

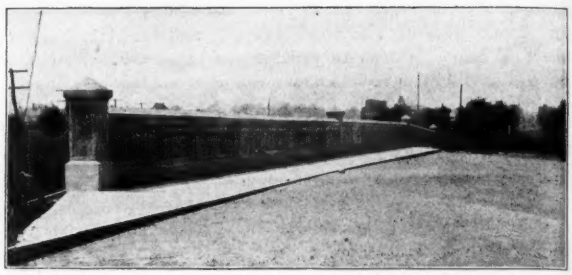


Fig. 8. Concrete Parapet Covering for Plate Girder Span, L. I. R. R.

The writer is indebted to Mr. L. V. Morris, Chief Engineer of the Jamaica Improvement, Long Island Railroad, for plans, photographs and data used in this article.

CONCRETE GRAIN ELEVATOR.

The Chicago, Indiana & Southern Ry., recently completed at Schneider, Ind., a reinforced concrete grain elevator with a total capacity of 250,000 bushels. The plant consists of a work house 42 feet square by 175 feet high, containing 15 bins 56 feet deep with a capacity of 80,000 bushels; eight circular storage tanks, 20 feet in diameter and 76 feet high, with a total capacity of 170,000 bushels; a drier building 27 x 32 x 52 feet high; a bleacher tower 6 x 6 x 62 feet high, and a power house 39 x 47 x 20 feet high, all of reinforced concrete.

The bin and building walls were poured in sliding wood forms 4 feet high, which were raised while concreting, so as to allow a maximum height of wall of 8 feet to be poured each day. The outer forms were metal lined to give a smoother surface. The bin walls are 7 inches thick, those of work house 8 inches and the bleacher tower walls 6 inches thick.

AUTOCLAVE TEST PATENTED.

A patent has been granted to H. J. Force, chemist and engineer of tests, D., L. & W. R. R., on the autoclave test for cement as described in the D., L. & W. R. R. Specifications for Portland cement published on page 143 of the March, 1913, issue of Railway Engineering.

The patent grants the following claims:

1. In the method of preparing solid bodies of Portland or similar cement for testing the same by boiling such cement bodies under pressure which exceeds 50 lbs. per square inch.

2. In the method of preparing solid bodies of Portland or similar cement for testing the same by boiling such cement bodies under a pressure approximating 285 lbs. per square inch.

Concrete is now being placed in the Snoqualime tunnel of the C. M. & P. S. Ry. in the Cascade mountains. This tunnel will be 11,700 feet long, of which over 3,500 feet has been driven. It is estimated that two years will be required to complete the work. The line will be shortened 3.6 miles, some heavy grades between Rockdale and Keechelus eliminated and snow troubles done away with by this tunnel.

The preliminary estimates of the Portland cement industry in 1913 have been completed by Mr. E. F. Burchard, of the United States Geological Survey. They show that the total production was 92,406,000 barrels, as against 82,438,096 barrels for 1912. The total number of barrels shipped, 88,853,000 barrels; stocks on hand at the end of 1913 amounted to about 11,375,000 barrels.

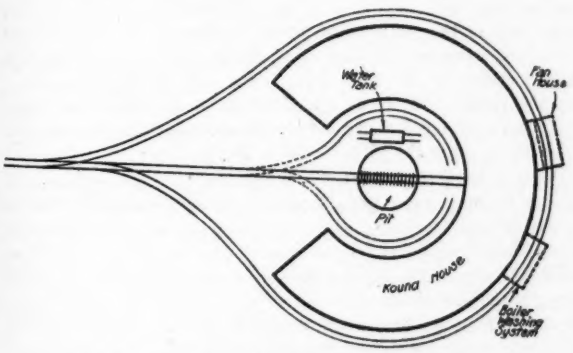
CONCRETE WORK ON ENGINE HOUSE.

C. L. VanAuken.

The concrete work on an engine-house presents some problems in concrete somewhat different from those found in ordinary work. The volume of concrete is small per unit foot, especially where only the foundations are of concrete. Another difficulty is the distribution of the work, all in a circle covering a comparatively small area, and where there is therefore liable to be much congestion.

If the appropriation or policy of the railway company permits the installment of a tower and gravity distribution system, the problem is somewhat simplified. But such a plant is, in general, not available when a railway company is doing its own work.

On the Proviso enginehouse it was decided to use the standard concrete mixing plant used by the Northwestern Ry. The layout of this standard plant eliminates all extra handling of material. The concrete mixer is located on a flat car, with a platform above at such a height that the laborers dump the aggregates into a funnel which leads down into the mixer. Just behind the mixer are the stone and sand in gondola cars as received. These materials are loaded by the laborers directly from the cars into wheel-barrows standing on a continuous platform or runway laid along the tops of the gondola cars. The platform is made up of short sections which are thrown off of the cars at the end of the day's work, and used again the following day. The cement is kept in a box car lo-



Construction Layout at Proviso Roundhouse.

cated back of the sand and stone cars. Laborers wheel the loaded wheelbarrows up the platform on one side of the cars, returning with empty wheelbarrows on the opposite platform.

This layout, as can readily be seen, entirely eliminates storage bins, and requires that no material be handled more than once from the cars to the mixer. The only disadvantage is that foreign cars, if used, are liable to be delayed and charged for, unless the amount of material shipped each day is looked after carefully, insuring a sufficient but never an excessive supply.

In placing the concrete for the circle wall and pit foundations in the enginehouse mentioned above, use was made of construction tracks on which the excavated material was hauled away. One track was situated just outside of the outer wall location, on a rather sharp curve. Another track ran straight into the enginehouse circle, at the point where the permanent entrance was to be. Two short spur tracks were situated just outside of the turntable pit, and could be connected up to the entrance track, by cutting and throwing it over. The sketch herewith shows this layout, and also shows the location of a water tank car on a short spur. This track was cribbed up as high as safe with ties, thus increasing the head of water by 5 to 6 feet. This tank supplied the water for the mixer.

All the concrete in the circle walls of the enginehouse, and the circle wall of the turntable pit was placed with metal chutes, using one or more ten foot lengths. Parts of the engine pit walls were poured in this manner. Beyond reach of the chutes, the concrete was wheeled in, in metal body wheelbarrows.

The use of the chute cut the cost of distributing the concrete for the whole job, to about 40 per cent of the cost by wheeling only. The cost of form work was high per cu. yd. of concrete placed, because the walls averaged only 15 to 18 inches in thickness. In spite of this fact, the cost of the concrete was kept down to about $5.50 per cu. yd., using ordinary company labor. All form work was of two inch lumber and this permitted the use of a wet mixture which did not require much tamping. The forms were made up for a quarter of the circumference of the enginehouse and were used four times.

THE EFFECT OF SALTS UPON THE STRENGTH OF CONCRETE CURED AT LOW AND NORMAL TEMPERATURES.*

The objects of the tests (made in 1912 at the University of Wisconsin) was to determine the effect of sodium chloride and calcium chloride, separately and together, upon a 1:2:4 concrete cured at temperatures below freezing and at ordinary room temperatures of from 60° F. to 75° F.

The concrete used was of a 1:2:4 mixture of Atlas cement, good quality bank sand and soft crushed limestone. The Na Cl, a common grainer salt and Ca Cl_2 an inexpensive, coarse grained, granular salt, were dissolved in the mixing water, the percentage of the salts being varied for different batches. For the salts used alone, the percentage of sodium chloride in the mixing water were 6, 9, 12 and 15 by weight, while those of the calcium chloride were 2, 4, 6, 8 and 10. With mixed salts the range was from 6 to 15 per cent for the sodium chloride and from 2 to 8 per cent for the calcium chloride.

The test specimens were made up in the shape of four inch cubes. Those cured at low temperatures were broken at ages of 14 and 60 days, while those cured at normal temperatures were broken at the age of 14, 60 and 360 days. Four specimens were broken at each age for each batch of concrete. For the specimens cured at low temperatures an effort was made to get the curing conditions as near as possible like the most rigorous ordinarily found in commercial work. These specimens were stored in the laboratory, at normal room temperature, for one day before breaking.

*Abstract from article by H. E. Pulver in the Wisconsin Engineer, Oct., 1913.

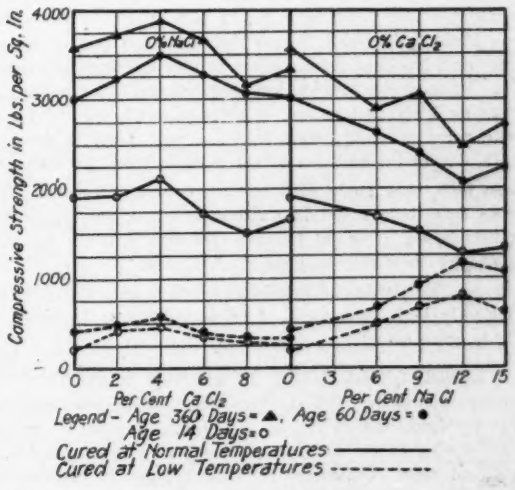

Compressive Strength in Lbs. per Sq. In.
4000
3000
2000
1000
0
0% Na Cl
0% Ca Cl2
0 2 4 6 8 0 3 6 9 12 15
Per Cent Ca Cl2
Per Cent Na Cl
Legend - Age 360 Days = ▲, Age 60 Days = ●
Age 14 Days = o
Cured at Normal Temperatures
Cured at Low Temperatures

Fig. 1. Compressive Strength of Concrete—Ca Cl_2 and Na Cl in Mixing Water.

Conclusions.

As the percentage of sodium chloride (Na Cl) is increased there is nearly a straight line decrease in the strength of concrete cured under normal conditions.

The effect of Na Cl alone, when added to concrete cured at low temperatures, is probably to reduce the freezing temperature, and hence retard the freezing of the concrete, thus permitting of its setting and hardening. The curves show an increase in strength for the addition of Na Cl up to twelve per cent, after which there is a decrease. It may be that, beyond twelve per cent, the weakening of the concrete due to the excess of Na Cl more than

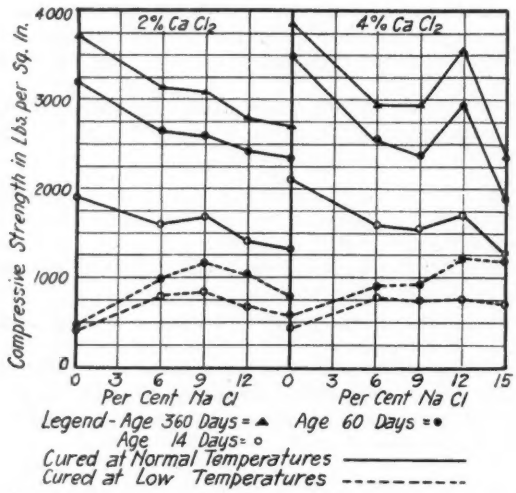

2% Ca Cl2
4% Ca Cl2
Compressive Strength in Lbs per Sq. In.
4000
3000
2000
1000
0
0 3 6 9 12 0 3 6 9 12 15
Per Cent Na Cl
Per Cent Na Cl
Legend- Age 360 Days = ▲ Age 60 Days = ●
Age 14 Days = o
Cured at Normal Temperatures
Cured at Low Temperatures

Fig. 2. Compressive Strength of Concrete. Varying Percentages of Na Cl and Ca Cl_2 in Mixing Water.

offsets the strengthening due to the reduction of the freezing temperature.

When calcium chloride (Ca Cl_2) alone is added to the concrete, cured either at normal or low temperatures, the effect is to increase the strength up to about four per cent Ca Cl_2, at which point the maximum strength seems to be obtained. This increase in the strength of the concrete may be due to the acceleration of the setting of the cement by the calcium chloride. Serious disintegration was observed on the surfaces of the cubes cured at low temperatures and 6, 8 and 10 per cent of the Ca Cl_2. This disintegration did not appear on any of the cubes cured at normal temperatures or where Na Cl was also used.

With concrete cured at low temperatures, the best effect seems to be obtained by using both Na Cl and Ca Cl_2 in the mixing water. From the curves it is seen that a two per cent Ca Cl_2 and nine per cent Na Cl mixture appears to give the most satisfactory results. For concrete cured at low temperatures, this mixture gives about as much strength as any of the mixtures tried, and for the concrete cured normally, there is not a very great reduction in strength, due to the addition of the salts in those percentages.

These tests were made with but one brand of cement. It is probable that there would be some variation in the results with other brands, but it is not thought that this variation would be great enough to affect the general conclusions.

It is possible that some brands of common salt might contain a sufficiently high percentage of calcium sulphate to affect the results to some extent.

SPECIAL FEATURES OF BRIDGE DESIGN.*

The abutments for slab bridges are usually low and comparatively rigid, and as it has been found impractical to provide for sliding of the superstructure over the abutments; it has been found more economical for slab bridges to provide sufficient steel to take care of the combined dead load, live load and temperature stresses than to provide a more or less complicated and expensive expansion point of low friction.

*Abstracts from the fourth report of the Illinois Highway Commission.

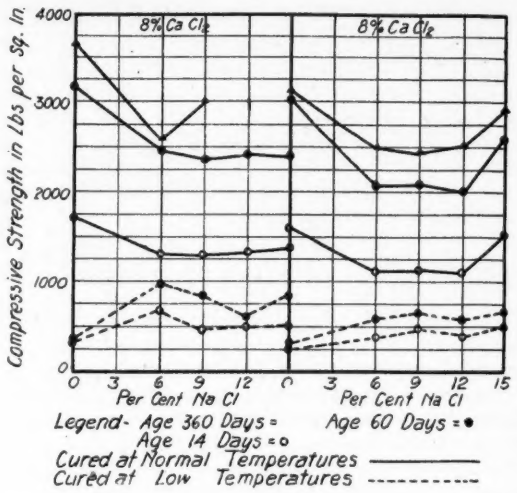

8% Ca Cl2
8% Ca Cl2
Compressive Strength in Lbs per Sq. In.
4000
3000
2000
1000
0
0 3 6 9 12 0 3 6 9 12 15
Per Cent Na Cl
Per Cent Na Cl
Legend- Age 360 Days = Age 60 Days = ●
Age 14 Days = o
Cured at Normal Temperatures
Cured at Low Temperatures

Fig. 3. Compressive Strength of Concrete. Varying Percentages of Na Cl and Ca Cl_2 in Mixing Water.

In the design of reinforced concrete girder bridges, however, it has been found more economical to provide for expansion at one end of the bridge than to use sufficient reinforcing steel to take care of the temperature stress in addition to the dead and live load stresses. The use of an expansion device of low friction justifies the use of a higher dead and live load unit stress in the steel. This is of considerable importance, particularly for long span reinforced concrete girders where the space available for placing the girder steel is limited.

Two satisfactory methods of providing for expansion in girder bridges have been evolved. In one method the wing walls of one abutment are entirely separated from the abutment wall proper, the latter being free to move at the top with the expansion or contraction of the superstructure. The wing walls are designed as self supporting. With girder spans up to 60 feet, the amount of movement either way is small and is taken up by the deflection of the main wall or a slight rocking of the wall on the footing. Earth pressure against the wall is of little importance in this connection as it but tends to reduce the tension in the girder steel during expansion and to cause the abutment wall to follow the superstructure during contraction. It does not increase the stress in the compression area of the girder as the load is applied at the bottom of the girder, tending by this eccentricity of application to reverse the dead and live load stresses in the girder.

This method, though entirely satisfactory, is somewhat objectionable, as a slight movement of the wings due to earth pressure and unequal settlement sometimes causes the wing walls to move forward slightly at the top, making a somewhat unsightly offset between the wing and abutment walls.

The present method of providing for expansion is to design the abutments and wings in the ordinary way, separating the superstructure completely from one abutment by a thick paper joint and supporting each girder at the free end on a single cast iron rocker of large diameter. The reaction is transmitted to the girder and abutment from the rocker through planed structural steel plates stiffened with I beams when necessary. The rocker in contact with plates is turned to insure perfect bearing, and its diameter is made proportional to the load imposed per lineal inch. The rocker is located in a pocket built in the abutment and filled with asphalt to exclude water or dirt and to protect the metal against corrosion. This method of providing for expansion has proven very satisfactory and is but little more expensive than the other method and besides

the added advantage that of mutual support of wings and main abutment wall is obtained.

Reinforced concrete abutments for steel bridges have proved to be economical when the height of abutment is 16 feet or more. Whether plain or reinforced concrete for abutments is cheaper depends, however, upon the cost of concrete materials at the bridge site as well as upon the height of the abutments.

The cantilever principle is now used for reinforced concrete abutments for steel bridges in preference to the buttressed or counterfort type. For heights of at least 25 or 30 feet the additional concrete and steel required for the cantilever type of abutment is more than compensated by the simplicity of form work and the arrangement of reinforcement. The cost of forms for the cantilever type is but slightly more than for plain concrete abutments of the same height, while the forms for the buttressed type of abutment are complicated and much more expensive. The lumber used for the cantilever type has a distinct salvage value, while that for the counterfort type is so badly cut that it has practically no salvage value. More steel is required for the cantilever type, but as little bending is required the total amount of steel can be placed at less expense than in the counterfort type where the bends must be numerous and more or less complicated. On account of the comparative simplicity, better workmanship and more accurate location of the steel is secured.

In the design of reinforced concrete abutments for both steel and concrete bridges, the following general method of design is observed: When local conditions require the wing walls to be built at an angle less than 45 degrees with the face of the abutment, both the main wall and wing walls are to be designed as self-supporting retaining walls of the cantilever type except the main wall for slab bridges; such wall to be designed as a vertical slab, supported at the top by the superstructure and at the bottom of the footing. The reinforcement in the main wall of slab bridges is, therefore, vertical and near the stream side of the wall, while the main wall of abutments for steel and girder bridges, the steel is also vertical but placed near the back face of the wall.

In practically all reinforced concrete abutments where the wings may be placed nearly parallel to the roadway or make an angle of more than 45 degrees with the face of the abutment, the wing walls are considered to act as counterforts and the reinforcing steel in the main wall is horizontal and placed near the stream face of the wall. This results in economy except when very wide roadways are used, in which case the span of the main wall slab may be so great as to make the cantilever type of main wall more economical.

In case the wing walls are parallel with the roadway, economy is frequently secured by designing the wings as vertical slabs supported at the bottom by the footing and at the top by a section of the wall reinforced as a horizontal beam, supported at intervals by tie rods across the roadway, which are surrounded by concrete. The excavation for this type of abutment is much less than for the cantilever type, as but little, if any, footing is required for the wings beyond the usual width.

All abutments and retaining walls are designed in accordance with the method of equivalent fluid pressures proposed by Turneaure and Maurer in "Principles of Reinforced Concrete Construction." An equivalent fluid pressure of 15 pounds per square foot is assumed for main and wing walls of all abutments unless the wings are parallel or nearly parallel to the main wall, in which case an equivalent fluid pressure of 21 pounds per square foot is used. For all work thus far built the use of the above equivalent fluid pressure in designing seems to have provided designs of ample stability.

In this connection it is interesting to note that during a period of seven years 533 concrete bridges at a total cost of $977,547 have been completed under the direction of the Highway Commission of Illinois.

CURRENT PRICES—CONCRETE MATERIALS.

Portland Cement—The cement market has advanced very little in the last month, but the prospects are very good for an increase of activities in all lines. Prices given of f. o. b. cars at points named, including cloth sacks, for which, in general 40 cents per barrel (4 sacks) is refunded on return in good condition. Prices per barrel (including 4 cloth sacks) are as follows: Boston, $1.72; New York, $1.58; Chicago, $1.55; Pittsburgh, $1.50; New Orleans, $1.64 on dock; Memphis, $1.82; Cleveland, $1.63; Detroit, $1.59; Indianapolis, $1.60; Toledo, $1.59; St. Louis, $1.55; Milwaukee, $1.55; Minneapolis, and St. Paul, $1.65 to $1.70; Montreal, $1.75 to $1.80; Toronto, $1.95; Winnipeg, $2.40 to $2.50; Kansas City, $1.63; Omaha, $1.78; Portland, Ore., $2.10; Spokane, $2.20; Seattle, $2.00; Tacoma, $1.90; Duluth, $1.78.

Crushed Stone—1½ in. stone, prices per cubic yard, f. o. b. cars in carload lots, unless otherwise specified. Boston, 80c per ton at the quarry; New York, 95c to $1.00, in full cargo lots at the docks; Chicago, $1.15; Toronto, 75c per ton at quarries; Spokane, $1.25; Seattle, $1.25; Portland, Ore., $1.00; Tacoma, $1.25.

Gravel—Prices given are per cubic yard f. o. b. cars in carload lots unless otherwise noted. Boston, 75c; New York, 95c to $1.00, in full cargo lots at docks; Chicago, $1.15; Portland, Ore., 85c; Spokane, $1.50; Seattle, 75c; Winnipeg, $1.85; Tacoma, 60c.

Sand—Prices are per cubic yard, f. o. b. cars in carload lots unless otherwise indicated. New York, 50c, full cargo lots at docks; Chicago, $1.15; Toronto, $1.15; Portland, Ore., 85c; Spokane, $1.25; Seattle, 75c; Winnipeg, $1.75; Tacoma, 60c.

Reinforcing Bars—The demand is increasing but the prices in general are about the same as those given last month. Pittsburgh base quotations on mill shipments f. o. b. cars, are from $1.20 per cwt., with the prevailing extras on bars under ¾ inch or base. The following are quotations on base bars per 100 lbs., for mill shipments from other points, f. o. b. cars: New York, $1.31; Philadelphia, $1.35; Chicago, $1.38; Portland, Ore., $1.25; Spokane, $2.25; Seattle, $2.15; Tacoma, $1.90.

Shipments from stock are being made at the following prices per cwt. f. o. b. cars: Pittsburgh, $1.70; New York, $1.90; Cleveland, $1.75; Cincinnati, $1.75; Chicago, $1.85; Montreal, $2.15; Toronto, $2.25; Winnipeg, $2.50; Portland, Ore., $2.10; Spokane, $2.55; Tacoma, $2.05; Seattle, $2.15.

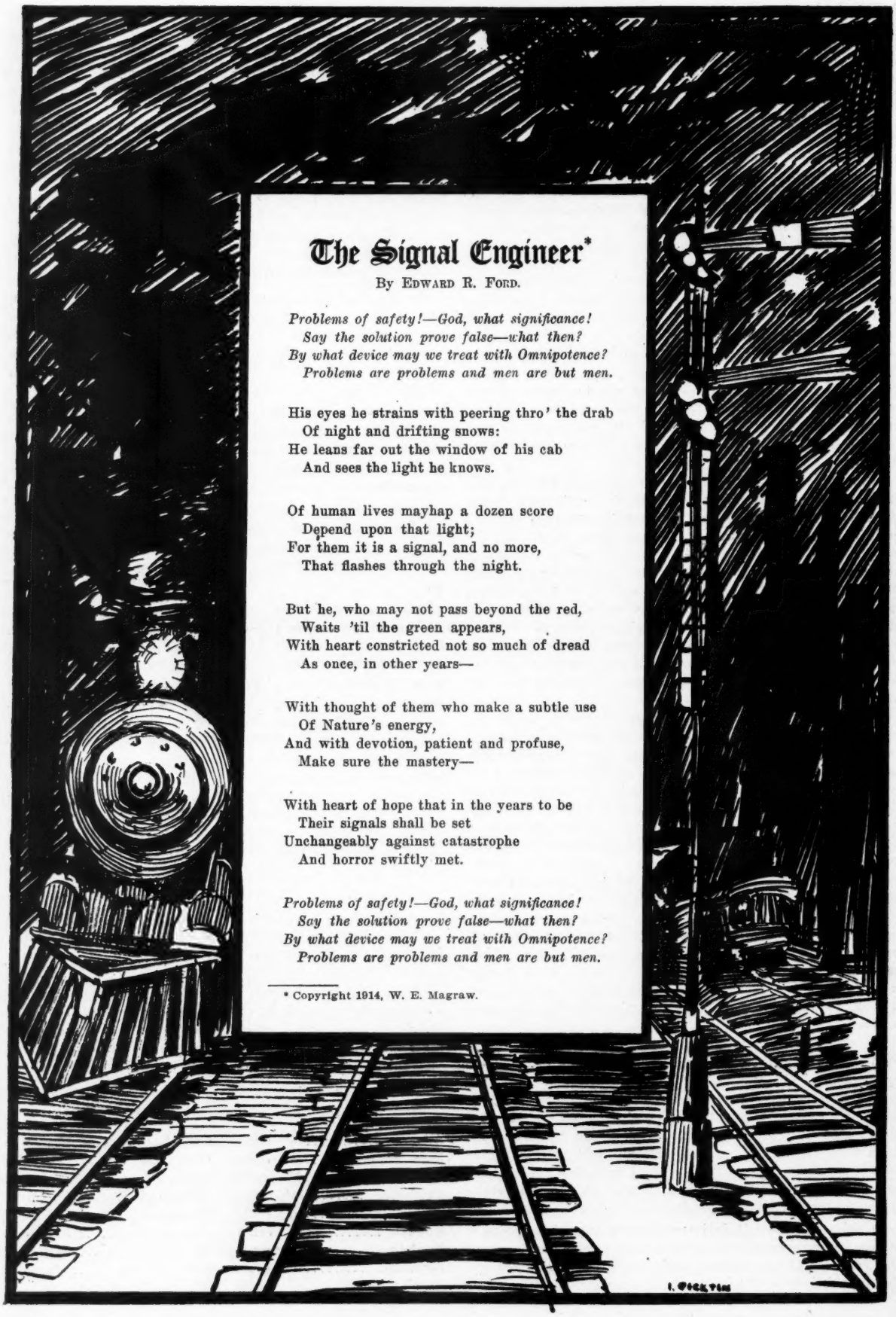
Metal Clips for Supporting Bars—$7.25 to $8.00 per 1,000, depending on size.

For the majority of the prices given we are indebted to the Universal Portland Cement Co., Concrete Steel Co., American Sand & Gravel Co., Chicago, and F. T. Crowe & Co., of Seattle, Portland, Spokane and Tacoma.

Reinforcing bars for mill shipments are in general sold on a Pittsburgh basis; this is, at the Pittsburgh quotation plus the freight to the point in question, and with the following list of freight rates on finished material and the Pittsburgh quotation given, the price of bars at any of the points listed can be readily computed.

From Pittsburgh, carloads, per 100 pounds to:

Albany	16 cents	Columbus	12 cents
New York	16 cents	Cincinnati	15 cents
Philadelphia	15 cents	Louisville	18 cents
Baltimore	14½ cents	Chicago	18 cents
Boston	18 cents	Richmond	20 cents
Buffalo	11 cents	Denver	84½ cents
Norfolk	20 cents	St. Louis	22½ cents
Cleveland	10 cents	New Orleans	30 cents
Birmingham	45 cents		



The Signal Engineer*

By Edward R. Ford.

Problems of safety!—God, what significance!
Say the solution prove false—what then?
By what device may we treat with Omnipotence?
Problems are problems and men are but men.

His eyes he strains with peering thro' the drab
Of night and drifting snows:
He leans far out the window of his cab
And sees the light he knows.

Of human lives mayhap a dozen score
Depend upon that light;
For them it is a signal, and no more,
That flashes through the night.

But he, who may not pass beyond the red,
Waits 'til the green appears,
With heart constricted not so much of dread
As once, in other years—

With thought of them who make a subtle use
Of Nature's energy,
And with devotion, patient and profuse,
Make sure the mastery—

With heart of hope that in the years to be
Their signals shall be set
Unchangeably against catastrophe
And horror swiftly met.

Problems of safety!—God, what significance!
Say the solution prove false—what then?
By what device may we treat with Omnipotence?
Problems are problems and men are but men.

* Copyright 1914, W. E. Magraw.

Joliet Interlocking

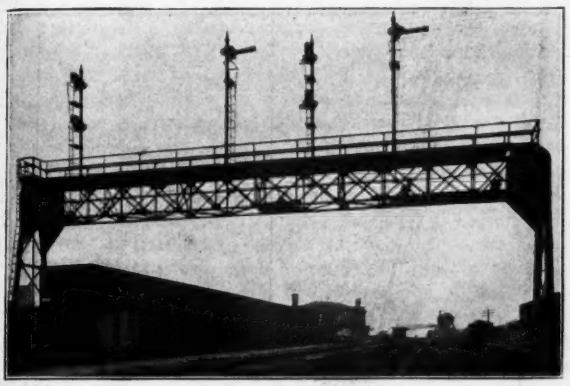
An Installation Developing Interesting and Original Features of Interlocking, Tower Design, Power, and Pocket Derails.

By B. W. Meisel.

In connection with the track elevation work through Joliet, Illinois, an all-electric interlocking plant of the General Railway Signal Co.'s type has been installed at the crossing of the Chicago, Rock Island and Pacific's four tracks with the Atchison, Topeka and Santa Fe and the Chicago and Alton's joint four tracks. The roads cross one another at almost a right angle, adjacent to which is located the Union depot.

Interlocking Machine.

This interlocking plant, which was recently put into service, comprises many interesting features from a signal standpoint. The interlocking machine is the G. R. S. Co.'s unit lever type, and has a capacity of 224 levers which is one of the largest if not the largest interlocking machine west of Chicago. A



Signal Bridge with Dwarf Signal Mounted on Bottom Chord.

picture of the interior of the tower at the interlocking machine floor level is shown herewith and illustrates very nicely the size of the machine and its equipment. Note the two ammeters, one on each end of the machine, mounted on a bracket arm and pivoted so that it may be adjusted to any angle, permitting the full view of the ammeters from any desired point of the machine or room.

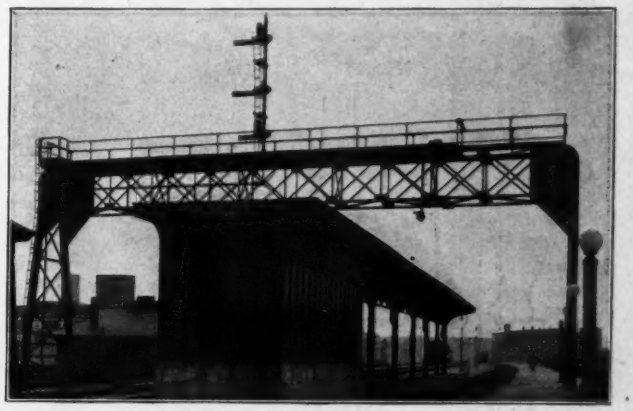
The distribution of levers is as follows: The Rock Island has 17 levers for 17 high signals, 6 levers for 6 dwarf signals, 1 lever for 1 suspended signal, 8 levers for 10 derails, 7 levers for 13 switches, 4 levers for 4 traffic locks, 4 levers for 4 section locks, 1 lever for 1 cross lock, making 48 working levers in 56 spaces. The Santa Fe and Alton have 25 levers for 25 high signals, 32 levers for 32 dwarf signals, 23 levers for 25 derails, 16 levers for 31 switches, 7 levers for 14 switches and derails, 9 levers for 9 M. P. F.'s making 112 working levers in 136 spaces. There are 2 spare levers in 3 spare spaces, making a total of 114 levers in 139 spaces for the Santa Fe and Alton. The total number of levers for all roads including the 2 spares, is 162 in 195 spaces, leaving a total number of 29 spare spaces in the 224 lever frame. In many cases one lever controls two functions; however, two spaces in the machine are used to do this, each space has a complete equipment for operating and indicating purposes, and the complete operation of a lever so equipped cannot be made until both functions have performed their full operation including the indication. Such functions as crossovers, two derails or a switch and a derail, or a switch and one end of a slip, are controlled in this manner.

Just behind the levers, at several points along the machine, are located track diagrams showing all switches, derails and signals. These diagrams are illuminated by bracket lights immediately above them. The picture of the interlocking machine mentioned above shows these charts and clearly illustrates their value. The route letters customarily used for manipulation purposes could not be employed here on account of the large number of routes, consequently the numbers for the functions were used instead.

Signals and Switch Machines.

All signals are of the model 2-A, D. C. type. The high signals are three position upper quadrant, operating from 0°-45° to 90° and the dwarf signals are two position upper quadrant operating from 0° to 45°.

With few exceptions high signals are mounted on signal bridges, and in one case a dwarf signal is suspended from the lower chord of a signal bridge. The difference in the

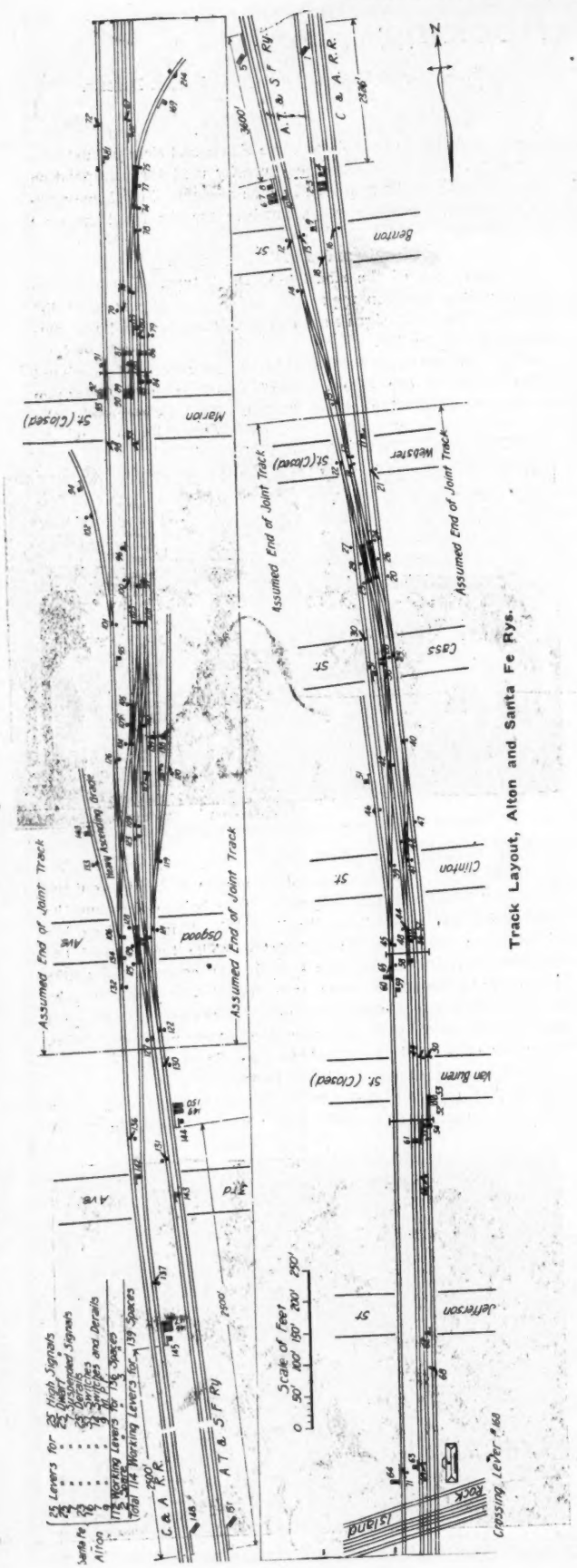


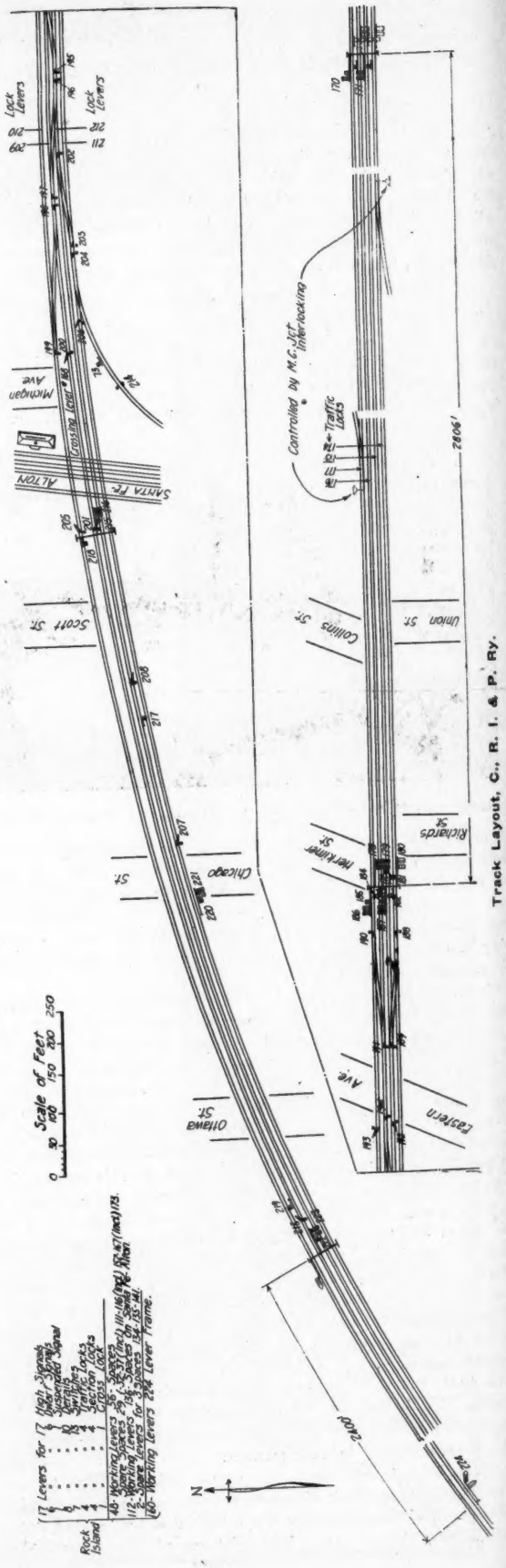
Signal Bridge with Suspended Dwarfs.

visibility between the suspended dwarf signal and similar signals mounted above the chord is very well shown on the two signal bridges shown herewith. The bridge showing the suspended dwarf signal is on the Rock Island lines. The other bridge is on the Santa Fe and Alton. The top arm of the two arm signals shown on the later bridge controls the traffic of the Santa Fe. The lower arm controls the traffic of the Alton. Both roads operate over a joint piece of track through the interlocking, and in all cases the signal arms controlling traffic for each road is as stated above.

All signals are electric lighted with two 5 watt 10 volt lamps from an A. C. source of power which is transformed to the proper voltage by means of transformers placed at suitable points

Interior of Tower, Showing Machine.


Track Layout, Alton and Santa Fe Rys.
Assumed End of Joint Track
Assumed End of Joint Track
Assumed End of Joint Track
Marion St. (Closed)
Osgood Ave
Alton
Berton St
Webster St. (Closed)
Cass St
Clinton St
Van Buren St. (Closed)
Jefferson St
Island
Rock
Crossing Lever #68
A T & S F Ry
C & A R.R.
Scale of Feet
0 50 100 150 200 250
25 Levers for 25 High Signals
Total 114 Working Levers for 139 Spaces
Santa Fe
Alton


Track Layout, C., R. I. & P. Ry.
Lock Levers
Michigan Ave
Santa Fe
Alton
Crossing Lever #68
Scott St
Chicago St
Ottawa St
Controlled by M.C.Jct. Interlocking
Traffic Locks
2806'
Collins St
Union St
Richards St
Harrison St
Eastern Ave
2400'
Scale of Feet
0 50 100 150 200 250
17 Levers for 17 High Signals
45 Working Levers
112 Spare Levers
(60 Working Levers 204 Lever Frame.)
Rock Island

from which the power is distributed to the signal lights. The lighting transformers are provided with several taps, so that a variable voltage in steps of one volt each may be had from 9 to 12 volts inclusive. The idea of course, is to take care of line drop.

All switch machines are G. R. S. Co.'s Model 2. A view of one of these machines, shown herewith, also illustrates the method of connecting the lock rod with the switch point by means of a very satisfactory switch point lug, which seems to be quite rugged and serviceable.

Track Layout.

The track layout has been reproduced here to show the extent of the plant, the location of all functions, the angle of the crossing, the location of the tower and to give a general idea of the situation.

Pocket Derail.

Due to the location of the depot at the crossing, it was advisable, in fact necessary, to arrange for closer approach to the crossing than the standard 500 feet distance from the fouling point at the crossing, and yet have the crossing protected in a satisfactory manner. Pocket derails were therefore provided in addition to the standard high speed derails. These pocket derails are located 50 feet from the crossing, and in order to get a device which would throw the wheels on the ground quickly and positively, there has been developed a very efficient type of movable point derail illustrated herewith. The frog point is 7 ft. $2\frac{1}{16}$ in. long and the stock rail from the point to the end is 13 ft. 4 in., the angle of departure being 9°-1'-0". The frog point has a 5 in. throw and when open the gauge side is supported and reinforced by rail braces, placed at the proper angle so that when the point is open each brace gives support and strength to the point. The stock rail is also supported by rail braces. All rail braces are upset in the field. The purpose of this upset is to take advantage of a certain amount of adjustment, possible after wear takes place, by drawing out the brace at the point of upset, as required. No guard rails are used in connection with the frog derails.

Insulated tie plates are used for all switches and derails like those shown in the view of the frog derail.

High and Low Speed Derails.

High speed derails are of the Wharton type, consisting of a point rail on the inside of the track and a riser rail on the opposite side to raise wheels high enough so that flanges will clear top of running rail. Derails on commercial tracks are of the Hayes type.

Conduits.

The main conduit leads are vitrified clay, containing lead covered cables. The cross leads are fibre. The specifications for both required that conduits be absolutely straight so that cables could be pulled through the ducts, without bending, to prevent injury to the cables and also to facilitate the work of drawing the cables through.

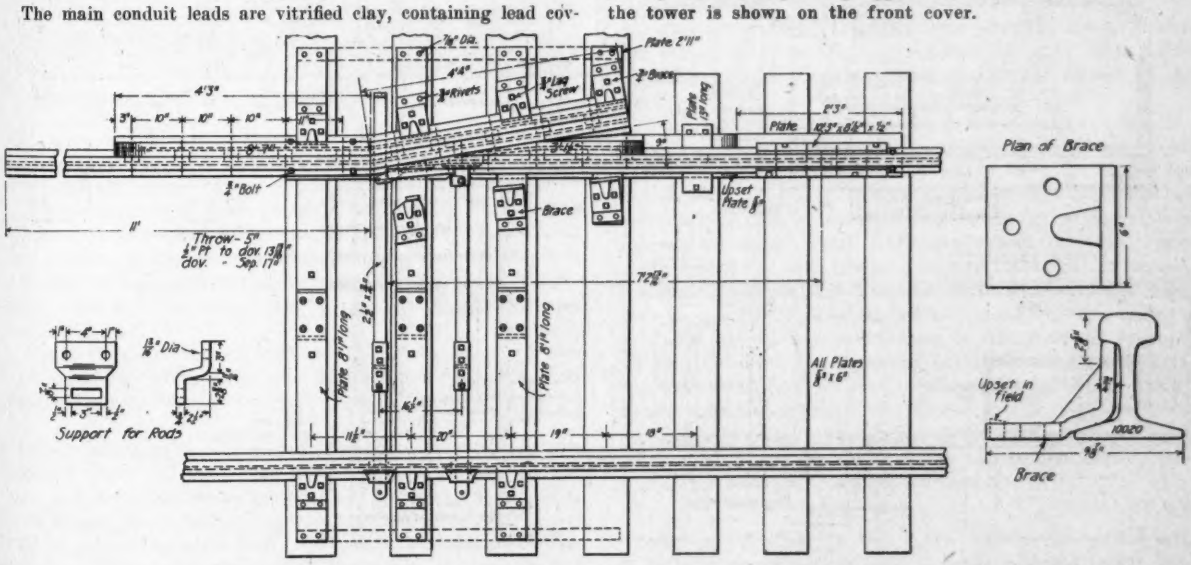
Switch Machine Mechanism.

Boot Legs.

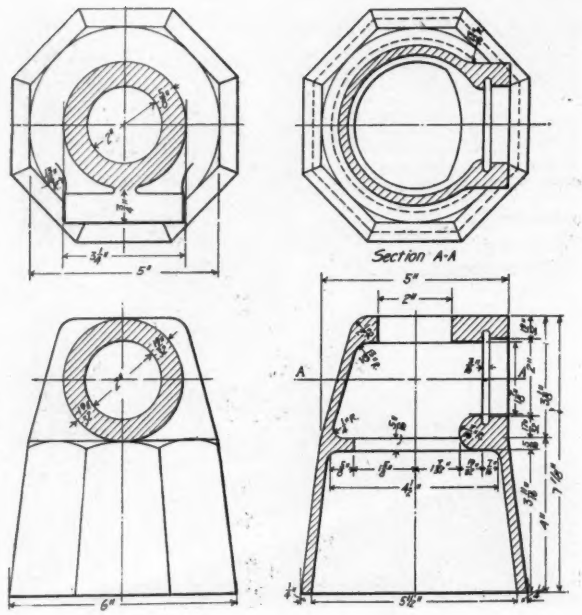
Two kinds of boot legs are used. Both are made of cast iron, the design of each being shown herewith. Scheme "A" is used for the wire outlets to switch machines. Scheme "B" is used for track circuit. Both forms are capable of a 6-inch adjustment to accommodate any raise that may be made in the track due to ballasting etc. The method of adjustment is by means of a telescopic connection in the concrete base, which is made in two parts and into which the boot leg is cast.

Interlocking Tower.

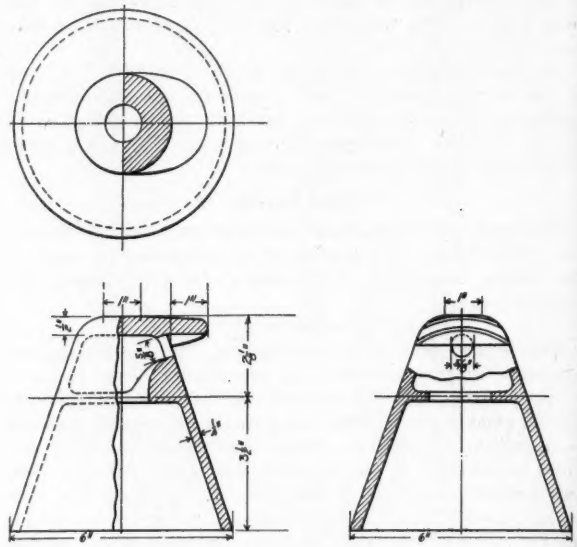
The interlocking tower has two stories and a basement. The outside dimensions are 17' 2" x 57' 2". The walls above the concrete foundation are plaster on hollow tile, which makes a very neat and pleasing appearance. An exterior view of the tower is shown on the front cover.



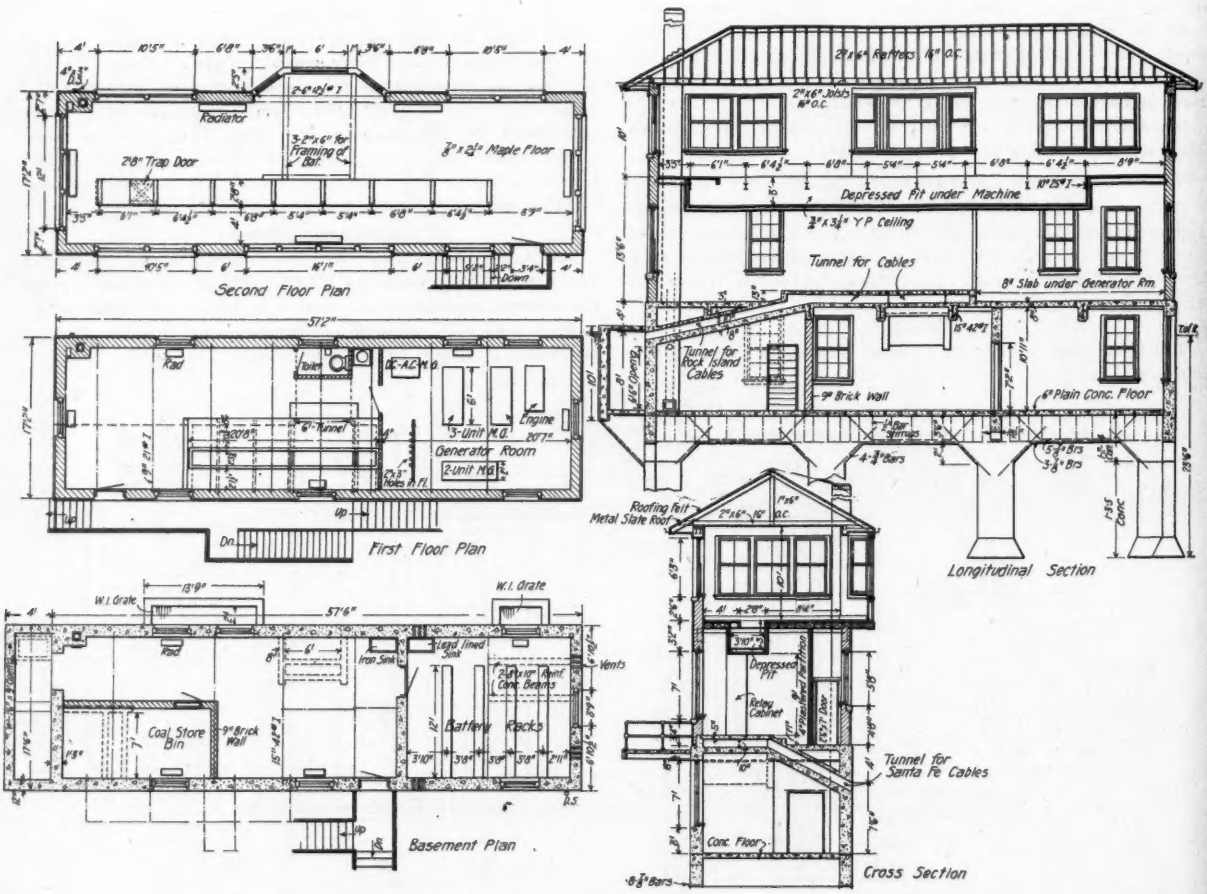
Quick Action Pocket Derail, Movable Frog Point Type.



Scheme "A." Cast Iron Boot Leg for Switch Machine.



Scheme "B." Cast Iron Boot Leg for Track Circuits.



Sections of Tower, Showing Type of Construction, etc.

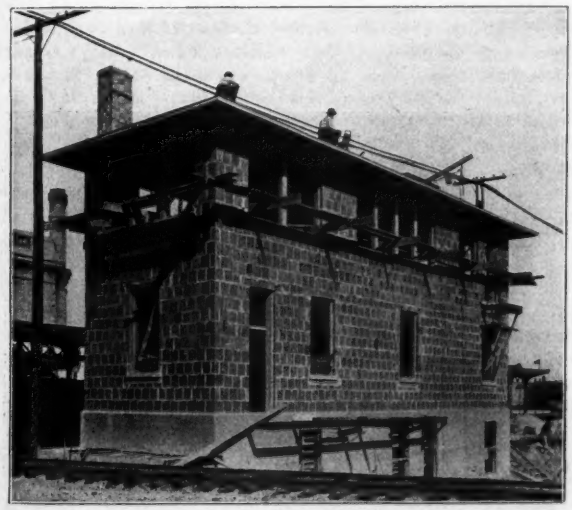
A very commendable and new feature in the tower is the pit provided under the interlocking machine, which extends a little more than the full length of the interlocker and is deep enough for a man to stand up and do the necessary wiring, repairing or inspecting, quickly, comfortably and efficiently. Provision has been made in the walls of the tower for outlets from which an extension light may be carried into the pit.

Another feature well worth noting is the tunnels between the first floor and the basement used for cable ducts. There are two of these tunnels at right angles to each other. One is 7′ wide and 10″ deep, and runs lengthwise of the tower, terminating in a manhole at one end. This tunnel is used for the Rock Island cables The other tunnel is 6′ wide and 10″ deep and runs crosswise of the tower at about its middle point. This tunnel, however, does not terminate in a manhole but the conduits run directly out of it to a manhole between tracks some distance away from the tower. The cables for the Santa Fe and Alton use this tunnel.

Floor and elevation plans are shown herewith and illustrate very nicely the pit under the machine, the tunnels, manhole, battery room, which is in the basement, generator room, directly above the battery room, relay rack space and interlocking machine location.

Type, Construction, and Cost of Tower.

The interlocking tower presents a neat and attractive appearance, and yet its design is very economical, for a permanent structure. The tracks being elevated, the lower story



Tile Work on Tower, Before Application of Cement Finish.

of the structure is below base of rail. The appearance from track side is that of a one-story building, and the width therefore does not appear narrow in proportion to the height.

The roofing is metal slate on roofing felt. The hip roof has eaves projecting quite wide which enhance the appearance of the building. The building is concrete to the second floor, cement and tile above, and rests on eight concrete pieces, four end and four intermediate piers. The end piers are L-shaped, while the intermediate piers are rectangular.

The wall above top of piers, while cast at the same time and monolithic with them, was designed as a 15x42-in. reinforced concrete beam to carry the upper portion of the building.

The reinforcing is indicated on the plan herewith, and consists of eight ⅞″ rods—five in the bottom on 2½ in. centers, and three in the top on 5-in. centers. Stirrups are ½-in. rods spaced as shown, spacing varying from about 12 in. over pier at point of greatest shear, to about 2 ft. at center between supports. Three of the five rods in the bottom of beam are bent up into top of beam over piers, which gives six bars in top at this point to take care of the negative bending movements.

The lower floor is plain concrete resting on the earth fill. The second floor is a concrete slab, supported by the walls and I-beams, and reinforced with American wire mesh—slab 8 in. thick under power machinery, while balance is 6 in. thick.

The hollow tile used was a recently perfected National type having rough, wedge-shaped ribs on the outsides, the outer edge of rib being the thickest, thus giving a very good mechanical bond. Special tiles were provided for sills, jams and windows. The construction photograph shows the excellent work done on the tile construction, and also shows the economical type of scaffolding used. The building is so narrow that beams for the supports of a scaffolding were run through the windows as shown.

The building is fireproof with the exception of the finish above the second floor. The plastering was Stonecote, manufactured by the Garden City Sand Co., Chicago. Two coats were used, a scratch coat applied directly to the tile, and a finishing coat applied on the scratch coat.

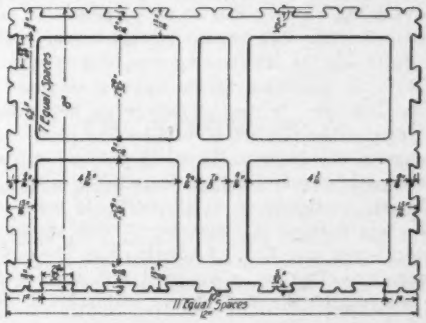
The face of the coating was marked before it had set, to resemble the Bedford stone in the depot across the track.

The building was erected under contract for about $10,000. The cost was high, due to going through a boulder and rubbish fill to bed rock, 4 ft. below natural ground surface. This type of building, when plastered on both sides of the tile, is usually cheaper than brick.

The contract was carried out by Leyden & Ortseifen, Monadnock Bldg., Chicago. The tile was furnished by the National Fireproofing Co., Pittsburgh, Pa.

Traffic Lock Levers and Approach and Section Locking.

Traffic levers are provided for each of the tracks on the Rock Island lines. These are operated in connection with a



Type of Hollow Tile Used.

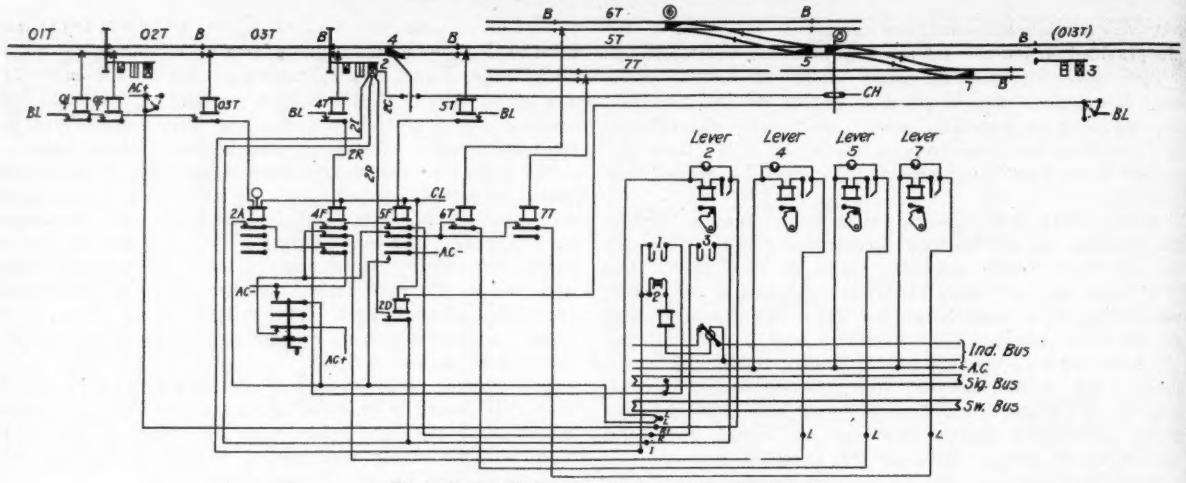
like number of levers located in the Michigan Central Junction tower, which is the next interlocking plant north. The home signals of the one plant are the distant signals of the other.

If it is desired to reverse traffic it is necessary for the towerman wishing to do so to communicate with the other towerman, asking him to reverse the traffic lever or levers for such a track or tracks. If he can allow this movement of traffic he will then reverse the proper lever, which mechanically locks up all signal levers controlling signals for train movements opposed to the traffic desired by the first towerman. The first towerman will then be able to reverse his lever since an electrical connection has been made between its lever lock and battery through contacts on the reversed lever of the second tower. The reversing of this lever will mechanically unlock the signal levers controlling signals for traffic in the direction desired. The typical circuit for the traffic lock levers between towers is shown herewith.

A typical circuit for the approach and section locking that is used for this plant is shown herewith.

Power.

Power is furnished by the Public Service Co. at 220-volt, 60 cycle, 3 phase and is used to drive a 3-unit motor gen-



Typical Circuit for Approach and Section Locking.

erator set, furnished in duplicate. A picture of these sets together with the remaining power equipment is shown herewith, except for the emergency gasoline engine and generator set. The object of the duplicate 3-unit set is to take care of any breakdown that may occur or in case repairs are necessary. The three units of each set are mounted on a single shaft. Each set has 2 generators, driven by a three-phase 60 cycle, 220 volt A. C. motor. One generator has a capacity of 40 amperes at 15 volts D. C. and is used, together with 5 cells of storage which floats on the line, for the track circuits. Another generator of the set has a capacity of 15 amperes at 10 volts and used, together with 3 cells of storage which floats on the line, for line circuit purposes.

The power for the high voltage storage battery (110 volts) used for operating the interlocking functions is supplied from a 110-volt D. C. generator driven by a three-phase 220-volt, 60-cycle A. C. motor. In case of emergency, power for operating the interlocking apparatus can be had from a 110-volt D. C. generator driven by a 7½ H. P. gasoline engine.

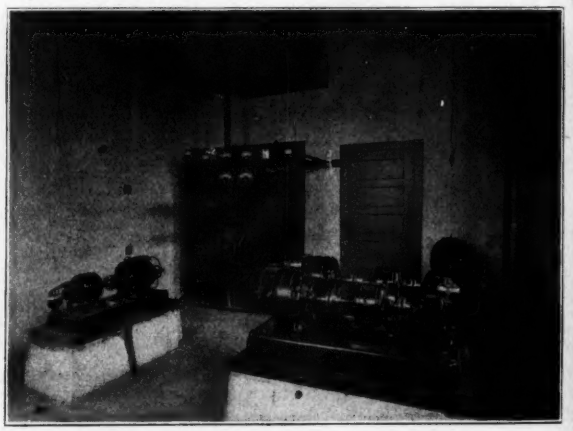
For emergency signal lighting there is a motor generator set, equipment consisting of a 110-volt D. C. motor, which is driven by power received from the 110-volt storage battery. This motor drives a ½ K. V. A. single phase 110-volt, 60 cycle A. C. generator. This set is equipped with a centrifugal governor, which controls the A. C. current within 5% of the desired frequency.

All storage batteries have a capacity of 160 A. H. and in every case float on the line.

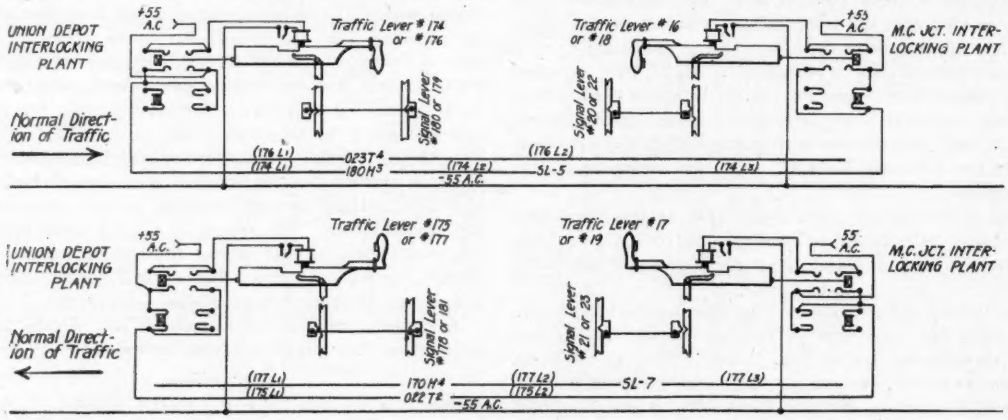
The power, furnished by the Public Service Co., is measured by a watt hour meter which records the total amount of current consumed. For the purpose of check on different parts of the interlocking, three other watt-meters have been installed, one in the line serving track circuits; one in the line circuit, and one in the circuit for the interlocking.

The interlocking plant was put into service in three sections as follows: first, the crossing and all functions on the Rock Island line; second, the junction of the Santa Fe and Alton at the south end of plant; third, the junction of the Santa Fe and Alton at the north end of plant. The last section was put into service Friday, April 24, 1914.

The plant was constructed, under contract, by the General Railway Signal Co. We are indebted to Mr. H. K. Lowry, signal engineer of the Chicago, Rock Island & Pacific, for plans and information from which this article was prepared.



Power Machinery.


UNION DEPOT INTERLOCKING PLANT
Normal Direction of Traffic
Traffic Lever #174 or #176
Signal Lever #180 or 179
Traffic Lever #16 or #18
Signal Lever #20 or 22
M.C. JCT. INTERLOCKING PLANT
SL-5
UNION DEPOT INTERLOCKING PLANT
Normal Direction of Traffic
Traffic Lever #175 or #177
Signal Lever #178 or 181
Traffic Lever #17 or #19
Signal Lever #21 or 23
M.C. JCT. INTERLOCKING PLANT
SL-7

Traffic Locks.

The Maintenance of Way Department

RAIL CREEPING No. 2.*

J. J. Hess, Asst. Engr. Maint. of Way.

Regarding the subject of rail creeping, I do not know of any subject of greater importance in the railway department, as from my point of view it affects almost every feature of maintenance. By causing ties to become slewed it seriously affects gauge, line, surface and drainage, four of what are conceded to be the most essential features of good track. By also causing inequalization of expansion, rails become badly battered at ends, anglebars become slot worn, bolts break or become loose and battered, spikes become worn and heads are cut off, due to rail movement, and there is great wear and tear on ties. Rail creeping also causes stock rails at switches and wing rails of frogs to get out of proper position, ends of rail at turn tables and on scales to interfere, as well as causing latter to get out of adjustment. Creeping rail also throws railroad crossings out of line and interlocking plants out of adjustment. It also causes track to kink and buckle, thereby being the cause of accidents that are sometimes attributed to causes unknown, the evidence, perhaps, having been destroyed. Great trouble is experienced on lines in Minnesota, due to there being so many swamps, marshes and what are termed muskeg swamps.

All of our main track, high speed passenger service lines and ore-carrying lines are laid with 90-lb. rail, 33 ft. long, with 20 ties per rail, or 3,200 per mile. We have as good quality of gravel as the country traversed produces, ranging in depth from 14 in. to 2 ft. under track.

Class and amount of traffic varies, depending on commodities hauled. Our ore carrying lines hauled 13,500,000 tons of ore the past season, 15,000,000 tons the previous season, in a space of seven months; also a large amount of grain, coal, forest products and L. C. L. shipments, besides six passenger trains and locals. Ore trains average a train haul tonnage of about 5,000 tons, with Mallet and Mikado type of locomotives, weight ranging from 76 to 158 tons on drivers.

Depth of cuts are as high as 35 ft. and fills are 90 ft. in places, but total average is low. Prevailing grade is 0.6 per cent adverse grade. Subgrades are well established and maintained, having a 20 ft. crown.

Surrounding country, which at one time contained a large amount of timber, is marshy and a great deal of same is now under cultivation and very productive, the only difficulty being to secure drainage, which is fast being provided.

Crossties 16 ft. in length were first used in constructing the worst portion of line referred to, in order to secure surface and resistance from rails creeping. Lateral and cross ditches were also established and entire fills were made of sand and ballast. After the long ties began to decay it was found that the roadbed had become solid enough to permit of standard ties being used, with a sufficient number of rail anchors, which at first consisted of two pieces of anglebars about 6 in. in length, one bolted on each side of rail and spiked to tie in slots provided. This method was found satisfactory and is still in use on single track. P. & M. anti-creepers are used on double track; two of them are generally ample, and are placed opposite joints where track is laid broken joints, although four are necessary and sometimes six to the rail in the worst muskeg swamps.

An additional amount of gravel on solid ground has been found to be a great help in preventing rail from creeping. This, however, is not much, if any, assistance in muskeg swamps, which are said to consist principally of decomposed vegetation, and a good many places have been found that by taking soundings bottom can be ascertained and grade loaded and sunk to solid bottom. But there are many miles where ground seems to consist only of soft spongy material which shakes when trains pass along, and it is in such places that the most trouble is experienced, due to wave motion of rails between car trucks with wheels far enough apart to permit same, which is the case except with ore cars, the wheels of which are so close as to prevent this. Trouble is experienced on descending grades and approaching places where stops are made, due to application of brakes.

Creeping of rails is becoming more of a factor to be reckoned with of late, due to truck wheels being so much farther apart, causing increased wave motion. Another tendency which is increasing the tendency of track to creep is the fact that more double track is being built, with traffic in one direction only on each track.

Density of traffic in one direction on single track is also a factor, as well as on grades, but the writer has never found any difficulties similar to rail creeping in muskeg swamps.

We have not had any experience with track not anchored by slot spikes at joint fastenings, but I am of the opinion that we are coming to the necessity of eliminating anchoring at joints, there being a good many advantages. One of the greatest is that of equal spacing of all ties, thereby procuring a uniform bearing and releasing joints from all other strain than that of maintaining surface same as other portion of rail. I think whatever additional expense would be involved, which in any event would not exceed two anchors to the rail to be as effective as the two joint ties, the results would justify.

A good deal of trouble is experienced on other portions of our line, due to rail creeping, especially on double track, and also where roadbed consists of sand, but I have taken up sufficient space in endeavoring to describe where our worst conditions are.

* Through an error, a portion of this article was omitted, as published in our April issue. The complete article appears herewith.

RAIL CREEPING.—NO. 6.

E. E. Jewell, Foreman.

I will suggest a few preventatives for creeping rail on grades which if carried out will prevent ties getting crooked in track.

In soft beds where track is through marshy land I have had some experience with four-rail anchors to each rail, putting them on ties opposite joint and in quarters. This will keep ties straight across, but will not keep rail from creeping on a grade of 30 feet per mile or over, for the ballast will shove right down hill. But on a good sound road bed, creeping can be prevented by using four rail anchors to every 33-foot rail. In this case they should not be put opposite joints but one should be put on short quarter and one on long quarter. On single track with heavy traffic I find that by putting anchors in quarters it saves joint ties. The joint will not work so bad on spikes. But on swampy bottom, unless anchors are put opposite joint on same tie, the ties will work crooked because ballast is not solid enough to hold.

On a grade, bolts in joints should be looked after closer than on level track and should be kept tight. If a track shows signs of creeping in summer, it is a good plan to loosen bolts on open joints and let rail work back, which it will do on a hot day. Bolts must be tightened again before night, and conditions can be helped to a great extent in this way if not entirely stopped. If the railways would do their share to stop rail creeping, foremen could maintain track better and easier.

The Grand Marais & Northwestern will complete construction of 40 miles of road this year and has located the right of way out of Grand Marais, Minn.

The Lansing Connection has been incorporated in Michigan with $50,000 capital stock.

RAIL CREEPING.—NO. 7.

By R. Pottol.

Every track man and maintenance of way engineer has had more or less experience with "creeping track." The greatest trouble from this source is experienced where double track is laid on a steep grade. Single track laid on easy grades is not apt to suffer much from creeping if kept in good or even fair condition. I have had charge of 50-lb. standard gauge single track which had square joints, angle bar inside and plain fish plate outside, four bolts and four spikes in each joint, with seventeen 6"x8"x8' redwood ties under each 30-ft. rail. Track was filled in with material excavated out of right-of-way—sand, gravel, clay, etc. This was an east and west track laid on easy grades, and the traffic was light, with tonnage about the same in both directions, and there was no trouble from creeping.

Most of my experience has been on standard gauge single track lines, ballasted with gravel. The creeping on these lines was so slight that we never gave it any serious thought, our greatest trouble being due to changes of temperature where track was laid without proper allowance for contraction and expansion.

I have, however, had charge of double track where creeping was very troublesome. This was a standard gauge north and south electric line, 60-pound rail, broken joints, four-bolt angle bars, with four spikes in each joint, and with sixteen 7 by 9-inch by 8-foot redwood (plated) ties under each 30-foot rail. Tracks were ballasted with a good quality of washed gravel to a depth of six inches under ties. The line was through a rough country with high fills, deep cuts and steep grades. On most of the north bound track the traffic was down grade, while, conversely, only a short stretch of the south bound track was down grade. There were several crossovers on the line, and a double track steam road crosed the electric line at grade.

The traffic on the steam road, both passenger and freight was heavy. For several miles on each side of the crossing there was a steep descending grade to the east. Both of these roads had considerable trouble from creeping track. There was no soft bottom, sinks or slides to contend with and the climate was ideal for track work—a long dry season and no extremes of heat or cold. The steam road was not double tracked until about two years after the electric road crossed it. The electric road was double tracked when first built. During the first year after the electric road had been put in operation, creeping could be plainly noticed on north bound track but it did not give any serious trouble. During the next year the creeping became still more noticeable; joint ties were moved out of square and spikes bent, spur switches and crossovers were moved out of adjustment, and the steam road crossing was being continually pushed out of line, making it necessary to cut the tracks frequently in order to drive it back into line. The following year anti-creepers were furnished, with orders to place two opposite each joint and one on each quarter, on the north bound track. By this time the joint ties were slewed out of square pretty badly. The creeping caused the crossovers to drag the south bound track out of line, and the steam road crossing required more frequent attention. The anti-creepers supplied were the kind that are fastened on the rail with a hook having a nut on the straight end. Before applying them, the joint ties were squared (without moving the rails). The crossovers were adjusted by opening joints and lining the tracks, and then putting short pieces of rail in. After the anti-creepers were applied there was no further trouble from creeping except where the anti-creeper nuts got loose. But the anti-creepers did not prevent the steam road crossing from getting out of line. Although it did not require such frequent lining as it did before the anti-creepers were applied, there was still a gradual movement in the direction of the traffic which made is necessary to cut the tracks and drive back the crossings occasionally. When putting on the anti-creepers, nut locks were used, still in order to obtain good results they needed close attention.

During the time that the steam road was single track it did not push or drag the crossings out of line very much. There was a slight movement down grade which had to be attended to occasionally, but after the second track was put in operation it became quite difficult to keep the crossings in line.

Eventually the officials decided to put on anti-creepers, and they procured the same make and style as the electric road was using, but in putting them on no nut locks were used. In a short time the nuts were loose, as no attempt was made to keep them tight. The company might just as well have dumped the anti-creepers into the scrap pile. The roadmaster flitted up and down the road on his motor car, the track walker gave his whole attention to the joints, and the foreman said it was impossible to keep the anti-creeper nuts tight without nut locks.

From experience and observation I have reached the conclusion that the proper time to apply anti-creepers is just as soon as possible after the track is laid. If not applied until after creeping has moved the ties out of square and caused other trouble, the joints ought to be moved back and the rails properly spaced with expansion shims. Squaring the joint ties without moving the joints leaves the joint ties too close to one shoulder tie and too far from the other. If nuts are used to fasten the anti-creepers on the rail, nut locks should be supplied and they should be kept tight at all times, otherwise there is no use in wasting money on them.

Appliances purchased from railway supply houses and put in service by railroads are not always properly applied or attended to. Then, after what seems to the management a fair trial, the company quits using the article. It would pay supply houses to send out inspectors occasionally to see that supplies furnished by them were properly applied and attended to. Then in case of neglect or failure to follow instructions the house could bring the matter to the attention of the general manager of the road at fault.

IMPORTANCE OF USING GREAT CARE IN TIE RENEWALS.

W. H. Haney.

Possibly some foremen are aware of the fact that available tie timber is becoming very scarce, and an item of great expense to the railroad companies.

A foreman can, by his good judgment, be a means of saving the company hundreds of dollars, or, on the other hand, make his work very expensive by removing ties from the track that there is still some service in.

No ties should be removed from track that will give the company one year's service; where the track is fairly well tied the time might be limited to six months, using good judgment.

New ties should be lined on double track on the inside, sixteen and one-half inches from the outside edge of base of rail to the end of the tie, except on curves, which should be lined on outside to give curves a nice, neat appearance.

In spiking new ties, spikes should be set straight and driven home in the same position. Care should be taken that the spike is not hit after the head of the spike touches the base of the rail, as it has a tendency to shove the spike backwards and weaken its capacity.

In gaging track, where putting in new ties, spikes should be drawn out of the old ties, and the rail moved to the proper position by lining it part of the way down, then heeling it up. If the rail is drawn in by "whipping" the spike it leaves an open space at the side, which fills with water and starts the tie decaying.

Where regaging and respiking, plug all spike holes with tie plugs, which prevents water from remaining in the old spike holes, which is very destructive to the tie.

In handling new ties, picks should never be stuck in the top of ties, always on the side. There seems to be a tendency among trackmen to stick their picks in the top of ties when pulling them under the rail. Often the ties become tight under the rail and a pick is used to pinch them through, using the rail for a heel, which is very damaging to the tie, besides giving it an ugly appearance.*

*Editor's Note: The use of tie tongs is becoming quite general, and entirely eliminates this trouble.

All ties should be put in with sap side up. In distributing ties they should be unloaded as near the point of insertion as possible. It is often noticeable that more ties have been put in track at a point where they have been piled on right-of-way than have been some distance away, indicating that rather than truck ties out to where actually needed they were put in where most convenient. This, you understand, is a vast waste of timber and very expensive. Some foremen take pride in the large number of ties inserted daily, but while the company is very anxious to receive good daily tie reports they are more anxious that the ties be put in economically.

Old ties should be piled and burned daily to keep right-of-way looking neat.

RAISING A TRESTLE BALLAST DECK WITH A CRANE.

By S. Cheatham, Roadmaster.

The illustration shows a method of raising a ballast deck trestle with a 100-ton Bucyrus steel derrick. This trestle is 2,800 feet long, and approximately twenty feet high. On account of the high water from the Mississippi river we wanted to raise this trestle fourteen inches, and after the matter was thoroughly decided upon and the engineering department figured out the approximate cost, which went up into thousands

Raising a Trestle Ballast Deck with a Locomotive Crane.

of dollars, the matter was discussed as to the best way of raising this bridge with the least delay to traffic. I thought the matter over considerably and finally conceived the idea of raising the trestle with the derrick. The matter was thoroughly discussed and considered, and some were of the opinion that it could not be done with the derrick, but, however, it was agreed upon to make a try at it.

We took the derrick and by using a 12x14 in. timber as a gallows to catch all the stringers, with a cable around the center pulling up through the center of the track, making loops to catch the short stringers, we raised this trestle with the derrick, and for a good deal less money than the estimated cost. We did this without any delay to traffic, and it was very satisfactory all the way around.

We made two lifts in raising this bridge fourteen inches. The first lift was six inches and the second lift put it high enough to put on the 14-inch cap.

The bridge is a surface deck bridge, built out of creosoted lumber. The deck contains eleven stringers, and is floored with 3x10 in. plank; the rock ballest under the ties ranges from four to six inches, and the deck is fourteen feet across.

The entire cost of raising the bridge in this manner was only $1.69 per lineal foot. I very strongly recommend this method to any man who has a bridge of this kind to raise and has a steel derrick, as it is very economical and successful.

COMPARISON OF METHODS, TOOLS AND APPLIANCES IN VOGUE YEARS AGO WITH THOSE OF THE PRESENT DAY.

By J. W. Powers, Supervisor of Track.

It is asserted by many that the Maintenance of Way department has not kept pace with the times, and that it has not made such rapid progress as has been made by the other departments. I believe that this is contrary to the views and opinions of the brightest and most advanced authorities in railway progress. To endeavor to dispel these erroneous ideas and also to prove that this department has improved with the passing years and to bring to light historic truth which shows how great has been the advancement in this department, which has fully kept pace with the times and is as far advanced as any of its co-laborers in the other branches, it will be necessary to compare some of the methods, tools and appliances in vogue several years ago with those of the present day.

In the early days of railroading, the permanent way was not constructed strong enough to sustain the increased strain recently put upon it, due to the heavy equipment and the increased speed of our modern trains. It therefore became necessary to increase the stability of the roadbed and structures upon which it rested; also to increase the weight and improve the quality of rails, fastenings, ties and ballast and all other important parts constituting a first-class track. After this had been accomplished it became necessary to improve the quality of the work.

A few years ago it was not considered unusual to find a foreman surfacing track without the use of a level board and sometimes putting in ties without the use of a gauge. But at the present time such methods would not be tolerated and would be considered a just cause for dismissal, for the best methods of doing work are a necessity. All men at the present time, in charge of track maintenance, realize the importance of accurate gauge, correct line and true surface, as the failure or lack of same will still further distort the condition of the materials in the track, and heavy trains moving at high speed striking such irregularities or surface, produce shocks and impacts, which constantly multiply the irregularities and make the track worse. In order to allow trains to ride smoothly at a speed of sixty to seventy-five miles per hour, it is self-evident that correct surfacing, gauging and lining is very important. Old methods have been rapidly abolished to adopt the more improved ones, on all progressive roads.

The majority of curves on roads which were built several years ago were plain circular curves, but the modern requirements for speed and heavy traffic made it imperative that the resistance of curves be reduced to a minimum for greater comfort to the traveling public as well as to reduce the excess of loss in motion, power and the incidental destruction of track. Therefore plain or circular curves have been changed to compound or easement curves, wherever circumstances will permit, and where the foreman is competent to properly treat such curves. The disagreeable shock received by trains is not felt on easement curves, as the train takes them with a gradual motion.

The track jack is one of the best and most economical tools in track maintenance. I can recall to mind some of the methods and tools used to raise track before track jacks were introduced. In some cases long raising bars were used, while in others large wooden levers or prys were used. In either case the progress was slow, and several men were required to handle the lever. Then the work was not done as satisfactorily as that accomplished by the poorest design of track jacks. The first design of track jacks which I remember using was known as the "Jennie" Jack. This jack was worked by friction and slipped when the rings became worn or on a rainy day, making it necessary to use sand on same to prevent slipping. On one ocasion when raising track with one of these jacks, it was necessary for me to leave the work for a few moments. During my absence one of the men conceived the idea that he could improve the working of the jack by pouring oil upon the rings. This prevented us from raising track for an hour or more, as we were obliged to

remove all the oil from the rings before the jack would operate.

Since that time many sweeping changes and improvements have been made and there are several well-designed jacks on the market. The old style ratchet drills were considered a very good tool a few years ago. Fifteen to thirty minutes were required to drill a ¾" hole through a ½" rail web. A great deal of a trackman's time was taken up drilling holes, especially in large yards. But the introduction of the Paulus drill has revolutionized the methods of drilling rails. Its construction enables the trackmen to work the machine in an upright position and the result is that they can drill four or five holes with less fatigue and exertion and in less time than it required to drill one with the old style ratchet drill.

A decided improvement has been made in rail benders and rail saws, and the adoption of the hydraulic rail bender has simplified the curving of rails. Steam excavators for heavy grading, loading ballast, etc., together with unloaders, ballast spreaders, levelers and specially designed cars, also ditching machines and power-driven appliances for loading and unloading frogs, switches, rails, bridge iron, piling and other heavy materials are used extensively on all progressive roads. The adoption of such appliances is a vast improvement over the old method of hand labor and reduces the cost, expedites the work and reduces to a minimum the liability of accident, which is ever present when handling heavy material by hand. Many new rails, frogs and switches were badly damaged by some of the methods and devices used in former years for unloading this material. While some were irreparably damaged, others showed only slight defects, but unless these defects were noticed and corrective remedies applied before they were put in track, they were seldom if ever remedied afterward. There is no doubt as to the economy and relative merits and advantages of recent usage over the older methods.

The cost of loading and distributing gravel constitutes a large item of expense in track maintenance. In former years the loading of gravel was performed by manual labor and a great many men were required. It was considered one of the hardest of labors which the men had to contend with. The men were obliged to work in embankments ranging from ten to seventy-five feet in height and on a summer's day when the thermometer registered from 90 to 95 degrees in the shade, it was sometimes beyond physical endurance, as anyone who has any experience in this work can attest. The men were sometimes paid by the car and other times by the day, but in either case it was slow as well as strenuous labor. But the development of steam shovels has eliminated all this hand labor and has also been the means of expediting the work and reducing the cost to a minimum. Only six to eight laborers are required to move the shovel and to keep the pit tracks in good condition. A steam shovel can load on an average about 1,800 yards per day and in former years to accomplish this it would necessitate the employment of at least 100 men.

Snow was handled a few years ago by methods which were slow, expensive and sometimes dangerous, due chiefly to the inadequate snow equipment then in use. The plows were so designed that when entering a cut it was necessary to face the cut and leave a clean flange way so that the plow could enter under the snow, as the plows were liable to be derailed unless this was done. If drifts were higher than the plow it was often necessary to shovel off the top and if the snow was hard, trenches had to be dug in order to break up the snow. The practice of shoveling out or widening cuts by hand is a very poor as well as an expensive one and it only affords temporary relief. As the snow is thrown upon the sides it tends to deepen the cut, which is again filled up by the first storm. But the invention and adoption of modern snow plows and the judicious use of the rotary plows, together with the protection afforded by the planting of trees, erection of snow fences and widening of cuts, has practically solved the snow problem. It has been the means of saving thousands of dollars annually and has enabled the northern railroads to operate their trains on schedule.

At the present time labor-saving devices of all kinds are supplanting sinew and muscle throughout the land. Such devices are evident in the roadway of many American railways. Much credit is due to the Track Supply Association for the vast improvements made in tools and appliances. The credit for improved methods in the Maintenance of Way department is due mainly to the men themselves, who though often surrounded by very unfavorable circumstances persevered in their endeavor to elevate the standard of their work. And when we compare the crude methods and extremely modest results and also the tools in use several years ago with those of the present time, it creates in the mind a just conception of the rapid strides made in this department. Credit should also be given to the various conventions held by the Maintenance of Way Association which has proven a powerful factor in distributing education and information broadcast through the medium of the various railway journals, portions of which are devoted to the interests of this department and through whose pages the deliberations of the brightest and most advanced authorities are brought to the notice of the men most interested. The advantages referred to were not available in former years and men possessed of good original ideas of performing work in the Maintenance of Way department had but little opportunity of utilizing them except in their immediate surroundings. But through the medium of such journals previously mentioned, a good idea, no matter where its origin, in a few weeks can be utilized throughout the land, and may be the means of benefiting thousands and in bettering the standard of their work.

While every department is fully launched into the struggle for advancement, the men of the roadway have not been dormant. They have discarded old and obsolete methods and have used to the best advantage the opportunities their surroundings afford and with hard work, honest endeavor and toilsome study have contributed their share to the marvelous progress made by railroads in the past quarter of a century.

BALLAST WHICH PROTECTS SUB-GRADE IN RAINY WEATHER.

By O. A. McCombs, Roadmaster.

During the month of December, 1913, torential and continuous rains in Texas caused the railways incalculable damage in slides and washouts, and delay to traffic on account of high water.

Among others the slide illustrated herewith came under my observation. This slide was in an embankment about thirty feet high. The fill was built several years ago with teams and scrapers, and wagons. The material, which was procured nearby, was a black land, river bottom loam.

This slide was caused by the rain falling on the embankment and not by high water of the stream. The embankment slipped off and went down for about 300 feet along the track, except in one place, where there was a block signal mast and battery. It broke so close to this signal mast that the slide met at the bottom of the embankment as it slipped out. This block signal mast and concrete foundation for batteries did not move with the slide. There had been driven outside of this signal mast and battery three piles about eight feet apart and a bulkhead built which held this part of the embankment in place. The slide went down on top eight to ten feet in places and to the end of ties on opposite side of track. The track was cribbed up and thrown over on the small part of the embankment left (which had been graded down about four feet) to let trains pass.

Figure 1 shows laborers filling slide and leveling grade preparatory to putting track back in proper place. This was on a tangent and the temporary track shows eight or ten ft. out of line. Note the signal mast standing where the embankment did not break. The piling driven there and the concrete foundation for these masts and batteries held the embankment. The ballast here was a good clean gravel with about 30 per cent of sand.

At another place there occurred a depression of four or five

ft. 200 ft. long, in an embankment. This embankment was about 35 ft. high and had been built by filling in a trestle. Several years ago the stringers and deck of the trestle were taken out and track put on track ties and gravel ballast.

The embankment previous to recent rains appeared to have permanently settled, but the recent continuous rains caused it to sink four or five ft., and left the track swinging on the old caps of trestle. The old caps were taken out, the track let down in the depression, inclines graded down at the ends and track was surfaced, cutting down the high places and filling in the low places so that trains were run through the depression.

Figure 2 shows this condition. The cause of this depression, as far as could be determined, was the settling of the earth into holes left in embankment by the rotting of the old bridge timbers left in the embankment when the trestle was filled. This condition shows that no timber should be left in an embankment if it can be gotten out at reasonable expense.

The most general cause of slides is the action of water on unsuitable material in embankments. The kind of ballast also assists or retards a slide. Rock ballast, cinders, sand and gravel that let the water right through onto the roadbed are not the best ballast for track where the embankment is liable

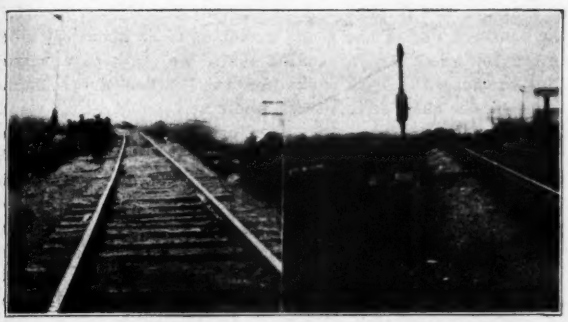


Figure 1. Figure 2.

to slide. The best ballast for such places is that which will shed water and keep the roadbed dry. Gravel that has just enough clay in it to pack into a solid mass is the best. Track ballasted with a good layer of this kind of ballast will keep the roadbed comparatively dry from falling rain.

I am familiar with a piece of track on an embankment 30 ft. high and about 3,000 ft. long, where in the wet weather and high water five years ago the embankment slipped away in various places. The slides continued until the toe was over 100 ft. from the track.

This dump had been built by filling a trestle 20 or 25 years ago, and was thoroughly settled, and was ballasted with rock. This piece of track was repaired and retied with good 9-ft. oak ties, and reballasted with a gravel ballast that had just enough clay in it to pack together in a solid compact mass.

During the recent wet spell in December, 1913, when the water was not very high on the foot of this embankment, there was no trouble at this place.

A few years ago I was in a locality where a lot of water fell in a short time, and tore out many railway embankments. I saw hundreds of feet of embankments three to ten ft. high that were cut down almost perpendicular from the ballast line on both sides of the track.

The embankment was not broken under the ballast, showing that it turned the water off and sheltered the embankment, the material in the latter being the same both under the ballast and outside of it. The ballast here was a gravel with just enough of a binder in it to pack it together in a hard mass.

G. W. HAYDEN has been appointed assistant to chief purchasing officer N. M. Rice, of the St. Louis & San Francisco, with office at the Frisco building, St. Louis, Mo.

HYDRAULIC METHOD FOR REMOVING SLIDES

By Steve.

In California, as a rule, we have no serious trouble with frosts; only in the high altitudes do we find frozen ground.

In leaving the state at the north and east, our railroads follow the rivers through and over the mountains; the roadbeds are principally of rock formation.

In the high Sierras, the winter snows are very deep, reaching at times the depth of thirty feet. In these mountains, the roadbeds are protected by snowsheds, the Southern Pacific Company having approximately forty miles of track protected by these sheds.

In the valleys we have very little snow. There are intervals of three to four years between snowstorms, and snow does not remain upon the ground more than a few hours.

Our most serious troubles are slides and washouts, occurring during heavy rainstorms or shortly after their cessation; in fact, in this part of the Pacific coast it can be said that we have but two seasons—wet and dry. The heaviest portion of the storm period occurs between January 1 and March 15. We seldom have rains between May 1 and October 15, and many years it is the last of November before we have rainfall.

As our frost troubles are immaterial, I will confine this article to slides and washouts, which occur here at a time when the northern and eastern roads are combating frost and snow. One of the very worst slides that I have helped to clear, however, occurred during the hot, dry season when the thermometer registered above ninety degrees. This slide occurred in the mountains in the northern part of the state, and was caused by a farmer irrigating his farm up on the side of the mountain. The formation beneath the soil was of a soapstone nature and inclined toward the track; the whole mass of soil for a quarter of a mile back moved toward the track, covering the roadbed for a distance of 750 ft. and to an average depth of 18 ft.

The slide was of too great a depth for a steam shovel to cast the debris over the sides, and were it possible to do so, it would leave a deep through-cut where before there had been a slight side cut.

The method used in repairing this slide was quite unique. Near by lived a man who was the owner of an equipment for hydraulic mining; this equipment was obtained from him and the pipe-line was laid up the mountain-side to a stream where the farmers obtained their water supply for irrigation purposes.

While the laying of the pipe-line was progressing, a five-yard steam shovel was being rushed from the central part of the state; the shovel arrived and was set up ready for work just as the laying of the pipe-line was being completed. The pipe-line was laid across the track behind the shovel to the lower side of the slide, and an 8-in. nozzle was attached to the pipe-line; this nozzle was operated by a springboard lever and on account of the terrific force of the water, six men were required to handle it; so strenuous was the work that these men were relieved each hour by others. The water was turned against the lower edge of the slide and was of such force and volume that it cleared away all of the portion of the slide that was on the lower side of the track, besides taking care of all the debris that was being cast out by the steam shovel, having no trouble at all in taking care of it all, not delaying the shovel at any time, but was in fact at most times waiting for the shovel to finish a cutting so as to add another section of pipe after having washed all of the debris from the slide that was within reach of the nozzle.

As the track was undisturbed, the steam shovel worked from the main line; some trouble was experienced at first, in obtaining secure footing for the shovel jacks, on account of the slushy condition of the earth at the sides of the track; this was overcome by laying a bed of ties on both sides of the track. Upon this tie-bed a number of rails six to eight feet in length were placed close together at right angle to the ties, and this gave the jacks a firm bearing, and the work went on with no further delay.

Near by was a lumber camp which had an electric lighting system; a temporary line was laid from this camp to the slide and several arc lights were installed, and the work of clearing the slide progressed night and day.

It was estimated that traffic would be blocked for a period of twelve days, had this slide been cleared in the usual manner, but in five days after the slide occurred the road was open again.

J. Clendenning, now roadmaster for the Southern Pacific Company at Tracy, Calif., was roadmaster of that district at that time, and was credited with this novel idea of clearing the slide.

In March, 1907, a terrific storm occurred in the Sacramento River canyon, resulting in many slides and washouts. In a distance of 35 miles there were from two to six of these slides or washouts to the mile.

As most of the slides occurred in side cuts, they were easily cleared, but a large one occurred in a through cut. This slide was of earth and was removed by "sluicing." As this is a western mining term, many may not understand it. In this part of the west much of the gold mining is done in the open and is called "placer mining," and is very simple, the apparatus used consisting of a number of boxes constructed without ends. These are constructed so as to allow one end of one box to be inserted into the larger end of the next one; these sluice boxes, or flume boxes as they are sometimes called, are laid on an incline, called a sluiceway, so that when water is turned into the upper end, it will flow fast enough to carry earth or gravel through the boxes when it is cast into them. I will not relate how gold is extracted by this method; my object is to give a clear understanding of the method we used in clearing the slide.

We laid the "sluiceway" for the whole length of the slide, then diverted a stream which crossed under the track at the upper end of the cut, into the sluiceway, then placed the laborers on both sides of this "sluiceway" for its entire length and engaged them in casting the earth into it, the water carrying the debris to the lower end of the cut and down over the embankment. When the clearing of the slide was almost completed and we could not finish by the use of the sluice boxes, we finished by opening the side ditches and washed the balance through these ditches.

In this canyon, during the period described, most of the washouts were side washes. The roadbed in most places was constructed on rock ledges, part of the roadbed being on solid rock and part on fill made from the material cast out at these points; some of the washes were straight down from the end of the ties, on the river side; other places were washed in as far as the center of the track. Many holes were very deep, so we did not stop to repair them, but lined the track in against the hillside. At places that did not give clearance enough for trains, we put drillers to work and shot out enough material to prevent interference with the passage of trains. As the greater portion of these washouts were on the outside of curves, the throwing of the track had a tendency to reduce the curvature; in fact, one of these curves was relocated and the curvature was reduced from ten to six degrees. Many of the temporary line changes made at that time were found to be more beneficial than otherwise. At one place, three curves reversed into each other with about 30 ft. of tangent between them. The tangent at the first curve was in direct line with the tangent of the third curve; the center curve was on a rocky point with a side cut of about 4½ ft. At the center of this curve there was a fill of 35 ft. long and over 25 ft. deep, which washed away. We started men to drilling around this rocky point to obtain material for filling this chasm; when the material was removed after the first series of holes was blasted, we found that we could line this curve in 8 ft. around the entire curve, thus reducing the curvature in all three curves. I have been informed that later the line was relocated at this point and all three curves were eliminated and the material that was excavated was used in strengthening and riprapping weak places at other points.

At the same time, down in the valley, the track in one place was washed from the grade and lodged against the fence for a distance of five miles. This was in still water or, as we call it, back water; the track simply raised out of the ballast and floated to the fence. As the water receded the track was towed back; the gang used a row boat to attach hand lines to the floating track; the track was drawn back and anchored upon or near the roadbed, and when the water receded sufficiently, the track returned to the grade. During the work some of the joints were found to be stretched open as far as the angle bars would permit, and in other places the joints were tight. A "bucking gang" was organized to equalize the expansion; this gang consisted of twelve men; they began "bucking" when about half of the track had been returned to grade. At the same time one-half of the force, which consisted of 130 men, was turned back to surface the track which already had been returned to grade.

The bucking was completed within a few hours after the other portion of the gang had finished lining the track back to the old track center stakes. This track had been ballasted four years previously and most of the stakes were still in center of roadbed. Traffic was resumed within five days after the roadbed was submerged.

Speaking of submerged track: Near Marysville, in this state, on a branch line through what is called "Nigger Jack Slough," the Southern Pacific had a low stretch of track about 3½ miles in length, which was inundated for a few days each winter. This was caused by back water from the Feather River. During these periods much of this track would be found floating, resulting in considerable damage. The foreman of this section had received several carloads of slag from the Southern Pacific Company's rolling mill at Sacramento, and he used this in various places where the roadbed had softened during storms; while he was making these repairs he conceived the idea that were it possible for him to obtain sufficient slag to ballast that portion of track, he could hold it in place when it was submerged. He applied for it and it was furnished him, as well as several coils of wire. When he had the track surfaced, and before it was filled in and dressed, he cut the wire in pieces of sufficient length to allow them to be fastened to the outside spike in a tie, then drawn down over the end of the tie and the loose end fastened to a piece of scrap iron or old stone paving block. This made a secure anchor when it was buried in about fifteen inches of broken slag; these anchors were installed at the quarters of the rails, approximately fifteen feet apart, the track was filled in to 3½ in. over the top of the ties, and this track remained stationary, and trains ran over it when submerged 10 to 12 in. over the top of the rail. The same method could be utilized by using broken stone.

During storms while patrolling track with a hand car, if they are available, I carry a bundle of empty sacks, also a coil of plain wire. Often when bulkheads at trestles begin to wash, we cannot stop the washing by throwing in or placing sacks of earth or sand. In that case, I take a piece of wire and lay it on the end of the ties, placing 12 to 15 sacks of sand or earth in a pile upon the end of the ties, then draw the wire tight around the sacks and tying it securely, roll this mass of sacks into the wash, rarely failing to check it in this manner.

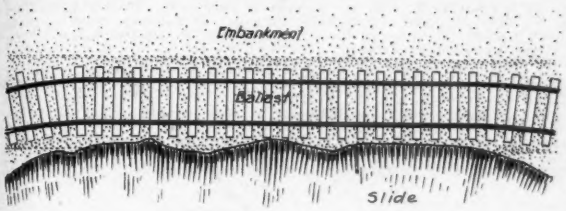
MR. J. B. BERRY announces the opening of an office as consulting engineer. He will be associated with Messrs. C. P. Howard and S. S. Roberts, under the firm name of Berry, Howard & Roberts. They will make a specialty of railway engineering, investigations, estimates and reports of existing or proposed lines, also the savings in operation due to changes of line or gradients; railway location; yard and terminal plans, and valuations for state or federal use.

WALTER A. JOHNSON has been appointed pneumatic tool manager at the Pittsburgh branch of the Ingersoll-Rand Company.

HANDLING EMBANKMENT SLIDE WITHOUT DELAY TO TRAFFIC.

V. H. Shore, A., T. and S. F. foreman.

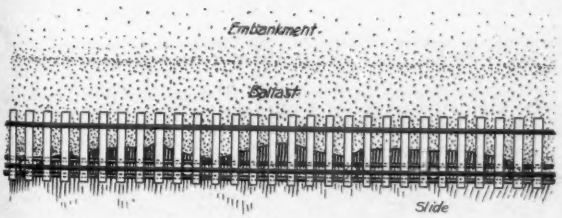
It very often occurs in embankment slide outs that about half or more of the embankment is left, and in this event half of the track is left swinging and the remainer is still on the roadbed as shown in sketch No. 2. Since most of our roadbeds on embankments have a width of not less than eighteen feet it can be readily seen that we have enough left to carry the track, with a narrow shoulder on each side. If not more than half has slid out or been washed away, by lining the track over on what is left and leveling up a little, trains can pro-



Sketch No. 1.

ceed at reduced speed, without seriously crippling traffic. Next there is required a pile driver and a number of short piles, also enough old bridge stringers to complete the work, all of which should be found on or near the division. The length of piling depends on height of embankment and extent of slide in depth, all of which should be taken into consideration when material is ordered. Bridge stringers of any length over ten or twelve feet can be used, as the piling can be driven this far apart with safety. New stringers may be used if others are not available, as they are put in only temporarily and removed after track is thrown back. The track is then filled in and given a short time to settle.

Sketch No. 1 shows the nature of the slide out, and the track thrown over for piling to be driven. The embankment originally was eighteen feet wide on top and slid out for about five hundred feet, being a new fill, and the slide out was caused by continued wet weather. It was a twenty-five-foot embankment and a mixture of sand, clay, and loam. Track was thrown over on about nine feet width of roadbed which was left, and was made safe for passage of trains at reduced speed, protected by necessary signals. When throwing the track, it



Sketch No. 2.

is necessary to make a reverse curve at each end of slide. Piling is driven in a line with normal position of the rail, under which the embankment is gone, and low enough to permit the thickness of a stringer, laid flatways, on top. Top of stringer should be level with bottom of track ties.

After piling is driven and stringers placed on top, the stringers should be fastened securely to the piling by driving drift bolts or good long bolts through bored holes and into the piling. Where joints or connections are made between stringers they should be made on the piling by cutting them so they cover just half the top of piling. Track is then ready to throw back to its former position and slide out can be filled by work train.

Much of the slide out embankment can sometimes be replaced by teams and shovels, making a good foundation. In case more than half of roadbed is gone, it may be widened by depressing the track, and then handled as above. This method can be used on either tangent or curved track.

TIMBER FLOATS OVER BOGS.

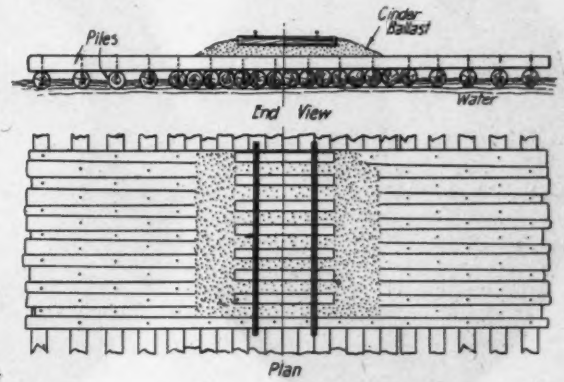
By Roadmaster.

I had an experience with a sink hole, or, in other words, maintaining track over one, on a line that was constructed in the year of 1874. A short time after the track had been laid over a bog, which we paid very little attention to at the time, a very bad sink hole developed. It was about five-hundred feet across.

After we discovered what we had to contend with, soundings were made as deep as eighty feet and we found no bottom to maintain piles. We put on a work train and began hauling in brush and small trees, even train loads of cord wood, which soon passed out of sight.

We then resorted to the making of mattresses out of willows, twenty and thirty feet in length, and placed them under the track which held it up for a short time and then gave away.

Finally we made a float out of old bridge timbers, thirty feet long, laid across under the track, and another course lengthwise of the track, drift bolted together. We then placed our track on this raft or float with gravel ballast, which we found was too heavy and caused the bog to raise up and run over on



Timber Float Over Bog.

the track. This ballast we shoveled off and replaced with cinders, which held up very well for many years by reducing the speed of all trains over it.

This bog, or sink, finally dried up to a great extent so it was possible for us to run our fastest trains at full speed over it.

When we double tracked this place we laid an additional timber float, or raft, in the same manner, along the side of the first and tied the two floats together with timbers and used cinders for ballast, which is holding up very well.

After completing the second track a large amount of money was expended in ditching. Today it is as good a piece of track as any railroad has.

I have met with several other sinks in the state of Wisconsin which we treated in about the same manner with tamarack poles fifty to sixty feet in length, using cinders for ballast.

Most of these sinks in Wisconsin were located in places which it was almost impossible to drain by ditching. I find, upon investigation, that sawed timber or long poles formed in a raft, submerged in one of these bogs, last indefinitely.

The repair shops of the Missouri, Kansas & Texas at Walnut Springs, Tex., which have been closed since the company took over the Central Texas, are being put in readiness for reopening. The road is also putting on additional men at points elsewhere, in accordance with the agreement reached in settlement of the state's suit against the company.

Personals

Although we are publishing monthly in these columns a practically complete report of all appointments of interest to our readers, it is probable that this information could be published earlier if each subscriber would make it his business to notify us of new appointments immediately. We request and we shall appreciate your assistance in this respect.

Operating

L. C. BRITTON has been appointed general manager of the *Alabama Central R. R.*, office at Jasper, Ala., succeeding A. Russell, who is now secretary.

P. C. ALLEN has been appointed superintendent of the *Baltimore & Ohio R. R.* at Philadelphia, Pa., succeeding J. T. Ohlhausen. S. A. JORDAN has been appointed superintendent at Winchester, Va., succeeding G. D. Brooke.

G. D. BROOKE has been appointed superintendent of the *Baltimore & Ohio R. R.* at Chillicothe, O. He was born at Sutherlin, Va., Sept. 15, 1878, educated in the public and private schools, and graduated from the Virginia Military Institute. From September, 1900, to June, 1902, he was instructor at Culver Military Academy, and entered the service of the B. & O. R. R. in July, 1902, as axeman. He was appointed assistant engineer in the office of the engineer of surveys in 1904, having held previously the positions of rodman, levelman, and transitman. In 1905 he was appointed assistant engineer in charge of trunk line surveys, and had charge of work in Pennsylvania and West Virginia. In June, 1907, he was placed in charge of construction work in West Virginia. He was appointed assistant engineer in July, 1908, and assistant engineer in the office of the general manager in March, 1911, in charge of studies of operation on various divisions. He was appointed assistant superintendent February, 1912, and superintendent of the Shenandoah division September, 1912. Mr. BROOKE is chairman of the Committee on Rules and Organization, American Railway Engineering Association.

O. G. HOPKINS has been appointed superintendent of the *Boca & Loyalton R. R.*, office at Loyalton, Cal., succeeding A. J. Boni.

R. L. PATRICK has been appointed general manager of the *Branchville & Bowman R. R.*, office at Bowman, S. C. He was general freight agent in 1909 and 1910, and auditor in 1911 and 1912, holding the latter position at the time of his appointment as general manager.

E. W. GRICE, formerly assistant to vice president, has been appointed assistant general manager of the *Chesapeake & Ohio Ry.*, office at Richmond, Va.

ROY W. CLARK has been appointed superintendent of the *Crooked Creek R. R.*, office at Webster City, Ia., succeeding G. I. Gadsby.

J. KEATING, formerly baggage agent, has been promoted to manager of the *Denver Union Terminal Ry.*, office at Denver, Colo., succeeding H. V. Miller.

As announced in our March issue, ARTHUR L. MILLS has been appointed general manager of the *Fort Smith & Western R. R.*, office at Fort Smith, Ark. Previous to this appointment he had been superintendent of construction, engineer of track, bridges and buildings, and finally chief engineer of the California Southern Ry.; assistant engineer of the Boston, Hoosac Tunnel & Western R. R.; resident engineer of the South Pennsylvania R. R., and assistant engineer, chief engineer, and general superintendent of the Otover Leaf R. R. He resigned the latter position to engage in private business and railway expert work.

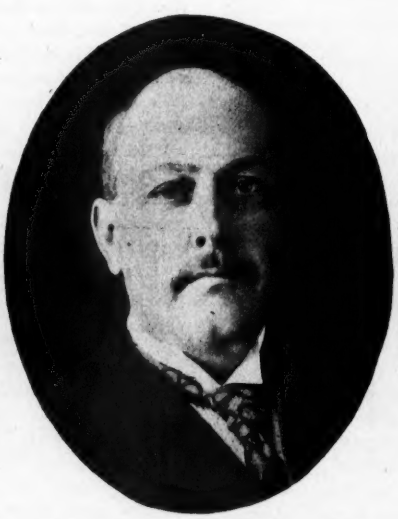
W. B. WOOD has been appointed general manager of the *Grand Rapids & Indiana Ry.*, office at Grand Rapids, Mich. He was born Sept. 11, 1876, at Harrisburg, Pa., graduated from Sheffield Scientific School in 1897 and entered railway work as rodman on the P. R. R., holding successively the positions of rodman, levelman and transitman. In 1899 he was appointed assistant engineer, and January 1, 1901, engineer maintenance of way of the C. & M. V. R. R. He was appointed engineer maintenance of way of the C. & P. division June 1, 1901, and July 1, 1903, was appointed superintendent of the Richmond division, Penn. Lines West. He was transferred as superintendent to the C. A. & C. division January 1, 1906; to the Akron division July 1, 1911; and to the C. & P. division January 1, 1912. On January 1, 1913, he was appointed superintendent of the Eastern division, which position he held till his appointment as general manager of the G. R. & I. Ry., as noted above.

J. E. ROBERTS, formerly superintendent of the Quebec, Montreal & Southern Ry., has been appointed general superintendent of the *Greenwich & Johnsonville Ry.*, office at Greenwich, N. Y., succeeding T. J. Lynch.

As previously announced, ROBERT H. ENGLAND has been appointed general manager of the *Kanawha & West Virginia R. R.*, office at Charleston, W. Va. He has been in the accounting department of the Buffalo, Rochester & Pittsburgh, and has held the positions of general freight and passenger agent of the Bath & Hammondsport R. R. and Lake Kouka Navigation Co.; general manager of the Oconee & Western R. R. of Georgia; general manager of Toledo & South Haven R. R. and its successor, the South Haven & Eastern R. R.; vice president and general manager of the New York & Pittsburgh Central R. R.; and vice president and general manager of the Central Railroad of Oregon.

As previously announced in these columns, H. A. BUTLER, of Mauch Chunk, Pa., became the president and general manager of the *Mauch Chunk Switchback Ry.* on February 28. MR. BUTLER was for a period of fifteen years the manager of iron blast furnaces at Parryville, Pa., until 1906. He was also for a number of years the secretary and treasurer and one of the directors of the Colonial Coal & Coke Co., and for the past three years has occupied the position of president of that company, which controls extensive coal and coke operations in Southwest Virginia. Mr. Butler is a brother of Mr. William R. Butler, who is one of the directors of the Lehigh Valley R. R.

GEORGE D. BROOKE, Superintendent
Baltimore & Ohio R. R.



ROBERT H. ENGLAND, General Manager
Kanawha & West Virginia R. R.

P. J. CARTER, Assistant Engineer
Atchison, Topeka & Santa Fe Ry.

As announced in our April issue, W. E. GREEN has been appointed general superintendent of the *Midland Valley R. R.*, office at Muskogee, Okla. From 1895 to 1898 he was general superintendent of the Chicago, Hammond & Western R. R., and resigned to go with the Kansas City, Pittsburg & Gulf Ry. in 1898, where he held successively the positions of superintendent, assistant general superintendent, and general superintendent. July 1, 1901, he was appointed general superintendent of the Shreveport, Red River Valley R. R. and May 1, 1901, he was appointed vice president and general superintendent of the St. Louis, South-Western R. R., and from April 1, 1907, to Sept. 1, 1908, he was vice president and general manager of the Trinity & Brazos Valley R. R., and president of the Houston Belt & Galveston Terminal Co. Aug. 1, 1909, he was appointed vice president and general manager of the Denver, Laramie & North Western R. R.

J. S. REDDOCH, formerly superintendent of the International Rys. of Central America, has been appointed superintendent of the *Missouri & North Arkansas Ry.* at Harrison, Ark., succeeding W. H. De Witt.

E. M. WRENNE has been appointed assistant superintendent of transportation of the *Nashville, Chattanooga & St. Louis Ry.*, office at Nashville, Tenn. W. G. TEMPLETON, formerly trainmaster, has been promoted to acting superintendent at Tullahoma, Tenn., succeeding G. D. Hicks.

J. M. RAPELJI, formerly general superintendent, has been promoted to assistant general manager of the *Northern Pacific Ry.*, office at St. Paul, Minn. A. V. BROWN, formerly superintendent, has been promoted to general superintendent at Livingston, Mont., succeeding Mr. Rapelji. W. E. BERNER, formerly trainmaster, has been promoted to superintendent of the Dakota division, office at Jamestown, N. D. He succeeds W. H. STRACHAN, appointed division superintendent of the Lake Shore division, office at Duluth, Minn., succeeding A. V. Brown, promoted.

STEWART STARR has been appointed general manager of the *Pascagoula, Moss Point Northern R. R.*, office at Moss Point, Miss.

F. J. KRON, formerly superintendent at Logansport, Ind., has been appointed superintendent of the *Pennsylvania R. R.* at Pittsburgh, Pa., succeeding W. B. Wood, promoted. R. K. ROCHESTER, formerly superintendent on the Vandalia R. R., has been appointed superintendent at Logansport, Ind., succeeding Mr. Kron.

A. L. CURRIE has been appointed superintendent of the *Quebec, Montreal & Southern Ry.*, office at Montreal, Que., succeeding J. E. Roberts.

W. M. COWHIG, formerly superintendent of transportation of the *Southern Ry.*, has been appointed superintendent of freight transportation, office at Washington, and his former office has been abolished.

H. E. HUTCHENS has been appointed superintendent of passenger transportation of the *Southern Ry.*, office at Washington, D. C. He was born in Butts County, Georgia, educated at Union Point Academy, and entered railway work as telegrapher in 1872 on the Georgia R. R. He held this position on several railways, and went with the Savannah, Florida & Western Ry. Sept. 1, 1882, where he was successively telegrapher, freight clerk, ticket agent, yardmaster, agent, chief clerk in the traffic department, assistant and finally master of transportation. March 3, 1896, he went with the Central of Georgia R. R. as yardmaster, and March 1, 1897, he was appointed assistant superintendent on the Atlantic & Danville Ry., where he was promoted to superintendent. He was appointed superintendent of the Norfolk division of the Southern Ry. Sept. 1, 1899, and superintendent of the Memphis division Jan. 1, 1901. He was appointed general superintendent of the Western, Southern, Eastern and Northern districts Jan. 1, 1907, which position he held till his appointment as superintendent of passenger transportation.

R. E. SIMPSON has been appointed general superintendent of the *Southern Ry.* at Greensboro, S. C., succeeding H. E. Hutchens. Mr. Simpson was born on Oct. 20, 1870, at Glen Alpine, Burke County, N. C., and received a common school education in the schools of that county. He entered railway service in the capacity of water boy for a section gang on the Richmond & Danville Ry. (now Southern Ry.) on April 13, 1884, was made section hand May, 1886, and one year later section foreman at Glen Alpine, in which capacity he served until February, 1889, when he was made extra gang foreman and conductor. In May, 1882, he resigned and entered the service of the Lehigh Valley Ry. as freight conductor, running out of Jersey City, and in September, 1899, he returned to the Southern Ry. as supervisor of the Asheville division, with headquarters at Hickory, N. C. He was promoted to roadmaster of this division in June, 1902, and since that time has served as follows: September, 1903, to September, 1905, roadmaster and trainmaster of the Murphy division; September, 1905, to January, 1907, assistant superintendent Atlanta division; January, 1907, to December, 1907, superintendent Spartanburg division; December, 1907, to May, 1909, superintendent Asheville division; May, 1909, to April, 1914, superintendent Knoxville division. His appointment as general superintendent was effective April 15.

F. S. COLLINS, formerly trainmaster, has been promoted to superintendent of the Mobile division of the *Southern Ry.*, office at Selma, Ala. He succeeds O. B. KEISTER, appointed superintendent of the Knoxville division, with office at Knoxville, Tenn.

W. G. SCOTT has been appointed general manager of the *Spokane & Inland Empire R. R.*, office at Spokane, Wash.

H. T. MALCOLMSON, formerly superintendent of car service, has been appointed superintendent of the *Toronto, Hamilton & Buffalo Ry.*, office at Hamilton, Ont., succeeding R. A. Barrett, resigned.

J. F. PATTERSON has been appointed superintendent of the *Vandalia R. R.* at Decatur, Ill., succeeding R. K. Rochester. Mr. Patterson was born in Alliance, O., Jan. 3, 1871, graduated from high school in 1884 and started work with the Pennsylvania as messenger. He advanced to telegraph operator in 1885, and was promoted to train dispatcher of the Western division in 1890. He was promoted to assistant trainmaster in January, 1899, and to trainmaster in October, 1899, holding the latter position until appointed superintendent.

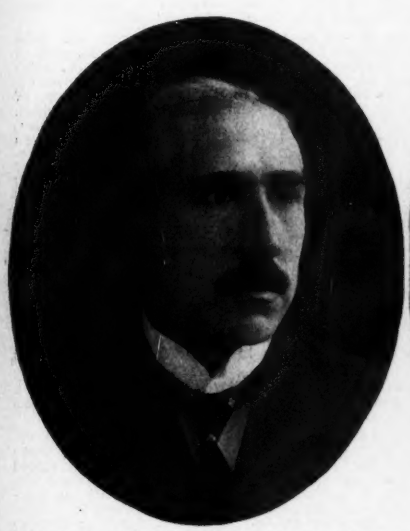
Engineering

P. J. CARTER has been promoted to assistant engineer of the *Atchison, Topeka & Santa Fe Ry.*, at Albuquerque, N. M., in charge of shop extensions at that point. He was formerly office engineer in the office of F. M. Bisbee, chief engineer of western lines at Amarillo, Tex.

JENKS B. JENKINS has been appointed valuation engineer of the *Baltimore & Ohio R. R.*, office at Baltimore, Md. P. PETRI, formerly division engineer at Connelsville, Md., has been promoted to division engineer of the Cumberland division, office at Cumberland, Md. R. BROOKE, formerly at Pittsburgh, has been appointed assistant division engineer at Newark, O. E. H. DOBSON has been appointed assistant division engineer at Pittsburgh, Pa., succeeding Mr. Brooke. H. L. GORDON, formerly assistant engineer, has been promoted to assistant division engineer at Foxburg, Pa., succeeding F. G. Hoskins, promoted. W. M. HIGGINS, formerly at Parkersburg, W. Va., has been appointed assistant division engineer at Wheeling, W. Va. L. W. STRAYER, formerly assistant supervisor, has been promoted to asistant division engineer at Parkersburg, W. Va., succeeding Mr. Higgins. A. H. WOERNER has been appointed assistant division engineer at Philadelphia, Pa.

J. B. MYERS has been promoted to district engineer of maintenance of way of the *Baltimore & Ohio R. R.*, in charge of the main line system between Philadelphia and Parkersburg, office at Philadelphia, Pa. He was born Aug. 4, 1879, at Frewsburg, N. Y., and was educated in the public and high schools there and graduated in the civil engineering course of Allegheny college. He entered the service of the B. & O. R. R. as a rodman at Pittsburgh on April 1, 1901; in June of that year he became a levelman, and in June, 1902, a transitman. He was promoted in May, 1903, to assistant division engineer at Pittsburgh, was transferred to Cumberland as assistant division engineer, and remained in that position from December, 1903, to May, 1907, at which time he was transferred to the Shenandoah division, with headquarters at Winchester, Va. Mr. Myers was advanced to division engineer and returned to the Cumberland division in August, 1907, and remained in that position until his promotion mentioned above.

F. G. HOSKINS has been promoted to division engineer of the *Baltimore & Ohio R. R.* at Connelsville, Pa. He entered the service of this railway August 1, 1907, as bridge draftsman, and was appointed assistant engineer in this department December 1, 1907. He was made bridge inspector December 1, 1912, and was promoted to assistant division engineer in charge of maintenance, Northern district, August 1, 1913, which position he held till his present appointment noted above.



JENKS B. JENKINS, Valuation Engineer
Baltimore & Ohio R. R.

E. G. LANE, District Engineer M. W.
Baltimore & Ohio South-Western R. R.

J. GUY HUFF, Division Engineer
Nashville, Chattanooga & St. Louis Ry.

E. G. LANE has been appointed district engineer maintenance of way of the *Baltimore & Ohio Southwestern R. R.*, office at Cincinnati, O. He entered the service of the B. & O. R. R. in 1888, and in 1898 he was granted leave of absence and was appointed captain of the Fifth regiment, Ohio infantry. He was appointed division engineer on the B. & O. R. R. in 1904, district engineer maintenance of way in 1906, and assistant engineer in the operating department in 1911. His appointment as district engineer maintenance of way at Cincinnati was effective April 1.

F. C. SHEPHERD, who has been appointed valuation engineer of the *Boston & Albany R. R.*, office at Boston, Mass., was born at Gloucester, Mass., and graduated from the high school at that place in 1888. He attended the Massachusetts Institute of Technology, college of civil and sanitary engineering, and in 1892 was appointed transitman with the Metropolitan Sewage Commission of Massachusetts. He was appointed assistant engineer on the Boston subway, and resigned in 1898 to go with the Department of Yards and Docks, Navy Yard, Portland, N. H. He went with the city of Boston in 1900 and was in charge of street watering assessments, and was deputy superintendent in charge of street cleaning for one year. In 1903 he was appointed resident engineer on the N. Y. C. & H. R. R. R., and in 1906 was appointed general superintendent of the Rourke Engineering Construction Co. He was appointed construction superintendent for J. G. White & Co. in 1908, in charge of the construction of a hydro electric plant at Jackson, Ga. He was appointed construction engineer of the Boston & Albany, April, 1912, in charge of new improvements, and then was appointed engineer of construction in charge of all improvements and grade crossing work. He held the latter position till his appointment as valuation engineer.

L. C. FRITCH is assistant to president of the *Canadian Northern Ry.*, office at Toronto, Ont., and not chief engineer as stated in our March issue.

J. C. IRWIN has been appointed assistant valuation engineer of the *Boston & Albany R. R.*, office at Boston, Mass. Prior to 1909 he was employed in various capacities in the engineering and operating departments of the N. Y. C. & H. R. R. R., and on that date he was appointed chief engineer of the Rutland R. R. In 1909 he was appointed assistant engineer in the office of the chief engineer of the Boston & Albany R. R., which position he held till his appointment as assistant valuation engineer.

H. C. BETTS has been appointed chief engineer of the *Bryan & Central Texas R. R.*, office at Bryan, Tex., succeeding A. B. Carson.

D. J. CORKERY has been appointed real estate and tax agent of the *Chicago & Alton Ry.*, office at Chicago, Ill. Previous to this appointment, since 1903, he was employed in the real estate and tax department of the C., B. & Q. R. R.

ANTON ANDERSON, formerly division engineer, has been appointed assistant chief engineer of the *Chicago, Indianapolis & Louisville Ry.*, office at Chicago, Ill.

H. C. LOTHHOLZ has been appointed engineer of design of the *Chicago, Milwaukee & St. Paul Ry.*, office at Chicago, succeeding J. H. Prior.

H. M. STONE has been appointed assistant engineer of the *Chicago, Rock Island & Pacific Ry.* at Des Moines, Ia., succeeding C. B. Wilson.

J. B. BERRY, assistant to president of the *Chicago, Rock Island & Pacific Ry.*, has resigned and opened an office as consulting engineer, Transportation Bldg., Chicago. He was for twenty years on the C. & N. W. Ry. in various positions in the engineering department—the last five years as chief engineer of lines west of the Missouri river. He went with the Union Pacific when Mr. Harriman and Mr. Burt were put in active charge and was with them nearly eight years. During this period the line was overhauled and changed, making the road what it is today, and in addition developed a good many other lines that have since been built. A portion of this time he was consulting engineer of the Oregon Short Line and also in an advisory way on the Oregon R. R. & Navigation Co. Since leaving the Union Pacific he has been with the Rock Island for eight and one-half years, seven and a half years as chief engineer, the last year as assistant to the president. While chief engineer he organized a force for valuation purposes, and as assistant to president he took charge of this work and also outlined federal valuation requirements. For nearly a year he has been one of fifteen engineers representing the carriers of the United States in dealing with the Interstate Commerce Commission Board of Engineers, adopting basic principles governing federal valuation.

F. M. BUTLER has been appointed chief engineer of the *East Broad Top R. R. & Coal Co.*, office at Orbisonia, Pa. He graduated from Geneva college in 1898, and served a year with the P. & S. E. R. R. as chainman and rodman. He then served a year as transitman on construction with the Western Allegheny R. R., and was with the Pennsylvania Lines West three years as assistant engineer, 1901-1904. He was appointed resident and later locating engineer of the C., C. & O. Ry., and in 1908 he was appointed engineer in charge of surveys for the Lawrence Power Co. In 1909 and 1910 he was engineer in charge of dredging and coffer dams at Hale's Bar Dam, Tennessee River. From 1910 to 1913 he was chief engineer for the Licking River Power Co. and the Tennessee Hydro-Electric Co., in charge of surveys and reports, which position he held till his appointment noted above.

R. BUDD has been promoted to assistant to president of the *Great Northern Ry.*, and A. H. HOGELAND has been appointed chief engineer, both with offices at St. Paul, Minn.

A. F. BLAESS has been appointed engineer maintenance of way of the *Illinois Central R. R.*, office at Chicago. He graduated from the University of Michigan, civil engineering college, in 1895, and entered the service of the Detroit & Mackinac Ry., serving as chainman and rodman. He entered the service of the I. C. R. R. as track apprentice in 1895, and after three months was made rodman, later holding positions up to assistant engineer. In 1902 he was appointed track supervisor, and in 1905 roadmaster. He was appointed assistant engineer maintenance of way in 1911, with jurisdiction also over the Yazoo & Mississippi R. R. He was appointed district engineer on the latter road Sept. 1, 1913, and district engineer of Northern lines, I. C. R. R., Nov. 1, 1913. He held the latter position till his appointment as engineer maintenance of way, noted above.

P. LADEN has been appointed district engineer of the Northern district, *Illinois Central R. R.*, office at Chicago, Ill., succeeding A. F. Blaess, promoted.

J. C. BECKWITH has been appointed engineer of construction of the *Intercolonial Ry.*, office at Moncton, N. B. W. A. COWAN has been appointed resident engineer at Truro, N. S.

As announced in our February issue, J. H. ROACH has been appointed assistant valuation engineer of the *Lake Shore & Michigan Southern Ry.*, office at Cleveland, O. He was employed from 1901 to 1907 in the bridge and building department of the Missouri Pacific Ry. as bridge designer and assistant engineer. In 1907 he entered the service of the L. S. & M. S. Ry., where he has been in charge of construction of new line and grade separation work.

As announced in our April issue, JOHN C. HOEHLE has been appointed architect of the *Louisville & Nashville R. R.*, office at Louisville, Ky. He was born February 28, 1884, and educated in the Louisville public school and high school. His first position was with J. J. Gaffney, and the next was with H. P. McDonald. From Mr. McDonald's office he went to the United States Engineer's office in Louisville, which at that time was under charge of Major Derby. He then went with the firm of McDonald & Dodd, and also was with Alfred Struck Co., contractors, of Louisville. He started work with the L. & N. R. R. Co. in August, 1905, and was appointed chief draughtsman of the Architectural Department in the latter part of the summer of 1912, which position he held until appointed architect.

A. F. FRENDBERG, formerly assistant engineer of the Kentucky division, has been appointed assistant engineer of the South and North Alabama division, Birmingham mineral division, and the Alabama mineral division of the *Louisville & Nashville R. R.*, office at Birmingham, Ala., succeeding J. R. Watt, promoted. R. W. MCCRUM, formerly resident engineer on line revision, has been appointed assistant engineer at Paris, Ky., succeeding Mr. Frendberg.

J. M. MYERS has been appointed engineer of construction of the *Manila R. R.*, office at Manila, P. I., succeeding C. J. Hoge.

J. S. LAUGHLIN has been appointed resident engineer of the *Minneapolis, St. Paul & Sault Ste. Marie R. R.* at Fond du Lac, Wis. D. MCINTOSH has been appointed resident engineer at Stevens Point, Wis.

R. C. WHITE, formerly general roadmaster, has been appointed engineer maintenance of way of the *Missouri Pacific Ry.* at Little Rock, Ark., succeeding H. E. Hale. J. S. BASSETT has been appointed assistant engineer at Monroe, La., succeeding A. W. Neel, transferred. R. M. CLARKE has been appointed assistant engineer at Wynne, Ark., succeeding F. A. Jones. A. W. NEEL has been appointed assistant engineer at Little Rock, Ark.

Following a reorganization of the engineering and maintenance departments, G. F. BLACKIE, formerly assistant engineer, has been promoted to engineer of roadway and track of the *Nashville, Chattanooga & St. Louis Ry.*, office at Nashville, Tenn. J. L. ALBERS, formerly engineer of design, has been promoted to engineer of structures, office at Nashville. C. H. BRODBECK, formerly assistant engineer, has been promoted to division engineer at Nashville, Tenn. J. GUY HUFF, formerly assistant engineer, has been promoted to division engineer at Atlanta, Ga. R. H. MCARTHUR has been appointed division engineer at Tullahoma, Tenn. R. M. MILAM has been appointed division engineer at Nashville, Tenn. I. O. WALKER, formerly assistant engineer, has been promoted to division engineer at Paducah, Ky. F. J. WALTER has been appointed assistant engineer at Paducah, Ky., succeeding Mr. Brodbeck.

R. H. COULSON, formerly resident engineer at Utica, N. Y., has been appointed resident engineer of the *New York Central & Hudson River R. R.* at Watertown, N. Y., succeeding W. F. Tenney. J. B. REINHARDT, formerly at Rochester, has been appointed resident engineer at Syracuse, N. Y., succeeding J. O. Borden.

W. B. THOMSON, who has been appointed division engineer of the *Northern Central Ry.*, and the *Pennsylvania R. R.* at Williamsport, Pa., was born at Mt. Savage, Md., March 24, 1867. He graduated at Lafayette College in 1886, and entered the service of the railroad in September of that year as rodman. He was made assistant supervisor on the West Penn division in 1888, and in 1889 he was transferred to the Eastern division of the old Philadelphia & Erie R. R.; in 1892 he was promoted to supervisor of that division. He was transferred to the Schuylkill division in 1897, and to the Philadelphia division in 1899, and was made assistant engineer of the Elmira and Canandaigua divisions of the Northern Central Ry. in 1901. Mr. Thomson's promotion to division engineer of the Williamsport and Susquehanna divisions was effective Feb. 11, 1914.

As announced in our March issue, CLARK DILLENBECK has been appointed engineer of bridges and buildings of the *Philadelphia & Reading Ry.*, office at Philadelphia, Pa. He was born at Palatine Bridge, New York, June 24, 1866, upon a farm, where he spent his boyhood days, and attended the district school until the age of fourteen, when he entered the Union Free School at Palatine Bridge. After spending two years there he entered the Canajoharie Academy, in the fall of 1882, and graduated therefrom in June, 1883. In 1884 he won the free scholarship to Cornell University from Montgomery and Herkimer counties, but on account of an attack of typhoid fever was prevented from entering the university until January, 1885. He then entered the university in the class of civil engineering, making up the lost term and graduating with the class in June, 1888, with the degree of Civil Engineer. He entered the service of G. W. G. Ferris & Co., a prominent firm of inspecting engineers, and spent a year and a half inspecting at the mills and shops of both the West and the East, gaining a practical knowledge of the manufacture of structural iron and steel. In May, 1890, he resigned to go with the Reading as assistant engineer, in the chief engineer's department. His first four years were devoted entirely to bridge work, assisting the late W. B. Riegner in designing new bridges. In 1894 he was assigned to building work, and had been in charge of architectural work till his promotion as mentioned above.

C. S. KIRKPATRICK has been appointed division engineer of the *St. Louis, Brownsville & Mexico Ry.*, office at Kingsville, Tex., succeeding E. S. Heyser.

As announced in the April issue, GEO. H. BINKLEY has been appointed chief engineer of the *San Francisco-Oakland Terminal Rys.*, office at Oakland, Cal. He was born at Richmond, Ind., educated at Depauw University, and commenced engineering work with the Pennsylvania R. R., with which company he remained five years on location surveys, construction and maintenance work. He was in charge of grading and field engineering at the World's Columbian Exposition, Chicago, remaining until a year after the close of the exposition to compile the final report of the Director of Works. He then went with the L. S. & M. S. Ry. and the C., R. I. & P. Ry. on track elevation, preparing subway plans for Chicago streets. For a short time he was connected with the Bureau of Streets in Chicago, and then went to the Calumet Electric Street Ry. as chief engineer in charge of construction and maintenance. He was for four years chief engineer of the Railway Department of Kohler Bros., contracting engineers, of Chicago, and later was vice president and chief engineer of the American Engineering Co., of Indianapolis. For four years prior to going West he was with the Arnold Co. Mr. Binkley is a member of the Western Society of Engineers and the American Society of Civil Engineers.

LAMONT ANDREWS, formerly assistant engineer, has been appointed engineer for the valuation board of the *San Antonio & Aransas Pass Ry.*, office at San Antonio, Tex. G. OLIVER has been appointed assistant engineer at Yoakum, Tex., succeeding Mr. Andrews.

E. A. FRINK has been appointed principal assistant engineer of the *Seaboard Air Line Ry.*, office at Norfolk, Va. He was born at Germantown, Philadelphia, Pa., Feb. 25, 1862, graduated from the high school at Westerly, R. I., in June, 1880, and in September, 1887, was employed by the Berlin Iron Bridge Co., of East Berlin, Conn., as sub-foreman in the yard, and the same year began the study of engineering under J. C. B. Lockwood, now president Seattle Operating Co. In April, 1891, he entered the office of the Berlin Iron Bridge Co. as draughtsman, and was made a checker in January, 1895, after which, until October, 1898, he was continuously in charge of work, and at times in charge of the drawing room. In October, 1898, he was employed by the Structural Iron Co., of Baltimore, Md., as assistant engineer in charge of the drawing and estimating department. In June, 1900, he was made chief engineer and general manager of the Structural Iron & Steel Co., successor to the Structural Iron Co., of Baltimore, Md. This company changed hands in 1902, and Mr. Frink formed a partnership with W. N. Hazen, M. Am. Soc. C.E., under the firm name of Frink & Hazen of Baltimore. Their offices were burned out in the Baltimore Fire of 1904, and Mr. Frink was employed by the B. & O. R. R. as draftsman in the bridge engineer's office from March to November of that year, designing bridges for the approach to the new Union Station at Washington. In Nov., 1904, he was employed by the Virginia Bridge & Iron Co., of Roanoke, Va., as superintendent of construction, to superintend the field forces of that company. In Feb., 1906, he left their employ to become bridge engineer of the Seaboard Air Line Ry., which position he held until appointed principal assistant engineer April 1st, 1914.

LOUIS CHEVALIER has been appointed engineer of buildings of the *Seaboard Air Line Ry.*, office at Norfolk, Va. He was born May 3, 1882, at Naugatuck, Conn., graduated from Tufts college in 1895, and was employed June 1, 1905, as draftsman with the American Bridge Co. He was employed by the Seaboard Air Line Ry. Nov. 15, 1906, and held consecutively the positions of draftsman, chief draftsman, and assistant bridge engineer. He was appointed assistant engineer in the bridge department of the B. & O. R. R. Feb. 15, 1910, and was appointed principal assistant to J. E. Greiner, consulting bridge engineer, Aug. 1, 1910. On June 1, 1913, he was employed by the Stillman-Delehanty-Ferris Co., engineers and contractors, as engineer, holding the latter position until April 12, 1914, the date of his appointment as engineer of bridges, S. A. L. Ry., as noted above.

W. L. DARDEN has been appointed engineer of buildings of the *Seaboard Air Line Ry.*, office at Norfolk, Va.

FELDER FURLOW has been appointed principal assistant engineer of the *Southern Ry.*, at Birmingham, Ala., as announced in our April issue. He graduated from Georgia School of Technology, class of 1903, B. S. C. E., and entered the service of the Southern Ry. as levelman in 1903. From 1904 to 1907 he was assistant engineer in charge of parties on preliminary and location surveys for both single and double track lines, and also prepared plans and estimates of cost for proposed reduction and alignment changes on present track. From 1907 to 1909 he was with the Sao Paulo & Rio Grande Ry., Brazil, S. A., as division engineer in charge of exploration and location surveys on 300 kilometers of line. He was with the Madeira-Mamore Ry., Brazil, S. A., in 1909 and 1910 as chief of exploration party for six months, and engineer of terminals at Porto Velho (headquarters) for six months. From 1910 to 1912, he was with Southern Ry. as assistant engineer, construction department, on surveys for revision of grade and alignment on main line in Southern district, and from 1912 to 1914, he was assistant engineer on surveys and costs of double track on independent lines and additional main track on present grade. From March 1st, 1914, he has been in charge of the Southern district, construction department, as assistant engineer, to the date of his promotion to principal assistant engineer.

A. HARRIS, formerly assistant engineer, has been promoted to resident engineer of the *Southern Ry.* at Birmingham, Ala. B. R. HUNDLEY has been appointed resident engineer at Memphis, Tenn. L. G. WALLIS, formerly assistant engineer, has been promoted to resident engineer at Richmond, Va. F. T. MILLER has been appointed assistant engineer at Knoxville, Tenn., succeeding Mr. Harris. M. P. NORTHAM has been appointed assistant engineer at Washington, D. C., succeeding Mr. Miller. L. D. BEATTY, formerly instrumentman, has been promoted to junior engineer at St. Louis, Mo. C. M. RATCLIFF has been appointed junior engineer at Washington, D. C.

J. A. HIGGS, JR., formerly assistant engineer of the *Southern Ry.*, has resigned and opened up an office as engineer and constructor at 1201 Holston National Bank Bldg., Knoxville, Tenn. He was born at Raleigh, N. C., March 2, 1888, and started city surveying work in 1904. He entered the service of the Southern Ry. in 1895 as back rodman, and left the railway to finish his education, receiving the degree of bachelor of engineering at the North Carolina College of Agriculture and Mechanics in 1906. He then re-entered the service of the Southern Ry. as field draftsman, and was later cement tester, draftsman and concrete designer until 1908 when he was appointed assistant engineer at Asheville, N. C. He was transferred to double track construction at Chattanooga, Tenn., in 1909. In June, 1910, he received the degree of civil engineer, and in 1911 he was placed in charge of all concrete work on the double track from Crosskeys to Gainsville, Ga. He was transferred to Erlanger, Ky., in charge of double tracking, and on February 1, 1914, he was transferred to the office of the principal assistant engineer at Knoxville, Tenn., where he was employed on miscellaneous work. He resigned April 1, 1914, and opened a consulting office, as noted above.

As announced in our April issue, J. C. LEEPER has been appointed chief engineer of the *Texas, Oklahoma & Eastern R. R.*, office at Broken Bow, Okla. His first railway work was in 1905 with the De Queen & Eastern Ry., on location and construction. In 1906 he was appointed instrumentman on the K. C. S. Ry., and in 1907 instrumentman on the M. & N. A. R. R. He returned to the K. C. S. Ry. in 1909 as instrumentman on maintenance, and was promoted to assistant engineer on drainage. In 1910 he went with the Stone & Webster corporation, which was building the Galveston-Houston Interurban Ry., and was promoted to assistant superintendent of construction in 1911. He held the same position on the construction of the El Paso-Yileta Interurban Ry. and on the Port Arthur-Beaumont Interurban Ry., resigning the latter position to become chief engineer of the T., O. & E. R. R., as noted above.

G. H. FRIEND has been appointed division engineer of the *Western Maryland Ry.* at Hagerstown, Md., succeeding J. M. Harris.

Bridges and Buildings

H. P. BLAKE has been appointed superintendent of water service and heating on the *Canadian Northern Ry.*, office at Winnipeg, Man.

S. PURSLEY has been appointed supervisor of bridges and buildings of the *Grand Trunk Ry.* at St. Henri, Que., succeeding S. Beattie.

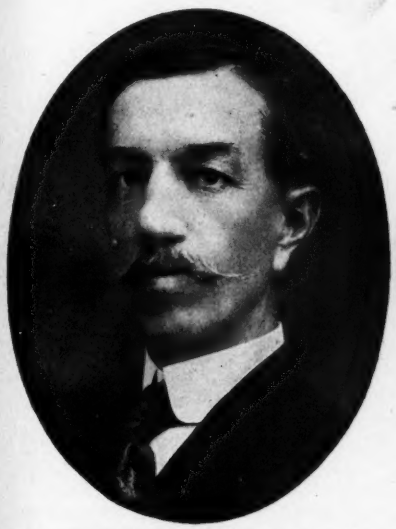
W. R. HALE has been appointed superintendent of bridges of the *Houston & Texas Central R. R.* at Austin, Tex.

P. F. GENTINE has been appointed supervisor of bridges and buildings of the *Missouri Pacific Ry.* at Pueblo, Colo.

Following a reorganization of the engineering and maintenance departments, DAN JOSLIN, formerly at Dixon, has been appointed supervisor of bridges and buildings of the *Nashville, Chattanooga & St. Louis Ry.*, at Nashville, Tenn. J. D. SHAVER has been appointed supervisor of bridges and buildings at Paducah, Ky. D. E. COUNTS, formerly masonry foreman, has been appointed superivsor of bridges and buildings at Kingsville, Ga., succeeding J. L. Earls. W. H. FLETCHER has been appointed foreman of water supply at Nashville, Tenn. D. M. SAGER, formerly plumber, has been appointed foreman of water supply at Paducah, Ky.

C. A. KLUTZ has been appointed master carpenter of the *Seaboard Air Line Ry.* at Richmond, Va., succeeding J. R. Gordon.

JOHN JOHNS has been appointed master carpenter of the *Staten Island Rapid Transit Ry.* at St. George, L. I., N. Y.



E. A. FRINK, Principal Assistant Engineer
Seaboard Air Line Ry.

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H. K. LOWRY, Signal Engineer
Chicago, Rock Island & Pacific Ry.

D. E. COUNTS, Supervisor B. & B.
Nashville, Chattanooga & St. Louis Ry.

Signalling

N. J. WESTERMARK has been appointed signal supervisor of the *Chicago, Milwaukee & St. Paul Ry.* at Tacoma, Wash.

H. K. LOWRY has been appointed signal engineer of the *Chicago, Rock Island & Pacific Ry.*, succeeding A. G. Shaver, resigned to engage in private business. Mr. Lowry was educated at the Massachusetts Institute of Technology in electrical engineering, class of 1904, and worked during two summer vacations in the signal department of the C., M. & St. P. Ry., starting in on mechanical construction as laborer. In the summer of 1904 he was again employed by the C., M. & St. P. as laborer on mechanical interlocking construction and in 1905 was transferred to the drafting table; in the fall of that year he was appointed signal inspector which position he held until December, 1908. He was then appointed assistant signal engineer and held this position until June 1, 1912, when he resigned. July 15, 1912, he accepted a position with the C., R. I. & P. Ry. as superintendent of construction, was appointed assistant signal engineer on the same road on January 15, 1913, and on account of reorganization of the department was appointed principal assistant signal engineer on August 1, 1913. He held the latter position at the time of his appointment as signal engineer, effective May 1.

W. H. STILLWELL, formerly draftsman on the N. Y. C. & H. R. R. R., has been appointed signal inspector of the *Louisville & Nashville R. R.* at Louisville, Ky., succeeding W. F. Hudson, resigned.

L. V. PARLE, formerly signal inspector, has been promoted to assistant signal engineer of the *Southern Pacific Co.*, office at San Francisco, Cal. O. A. CHARLTON has been appointed supervisor of construction and P. Dinkle has been appointed signal inspector, succeeding Mr. Parle, all with offices at San Francisco, Calif.

Maintenance of Way

E. Y. BLANKENSHIP has been appointed roadmaster of the *Atlantic Coast Line R. R.* at Newberry, Fla. W. H. FLYNN, roadmaster, has been transferred from Lake Butler to Trenton, Fla. E. C. ROGERS has been appointed roadmaster at Trilby, Fla., succeeding S. E. Melton.

C. W. SELBY has been appointed supervisor of road of the *Baltimore & Ohio R. R.* at Washington Jct. (postoffice Point of Rocks), Md.

H. A. MAYO, formerly bridge foreman, has been appointed roadmaster of the *Cape Girardeau Northern Ry.*, office at Perryville, Mo., succeeding H. W. Davis.

J. K. SLOATMAN, formerly inspector and engineer on the St. Clair yard, has been appointed assistant supervisor of the *Central R. R. of New Jersey* at Jersey City, N. J., succeeding R. V. Reamer, promoted.

H. N. WALTERS, formerly assistant supervisor, has been promoted to superivsor of track of the *Chesapeake & Ohio Ry.* at Richmond, Va., succeeding F. C. Singleton.

J. P. CORCORAN, formerly supervisor, has been appointed roadmaster of the *Chicago & Alton Ry.* at Bloomington, Ill., succeeding F. M. Corbett. HENRY KLEINE, roadmaster, has been transferred from Slater to Mexico, Mo. F. H. HANSON has been appointed supervisor at Joliet, Ill. JAMES MCCABE has been appointed supervisor at Springfield, Ill. GEO. MEYER has been appointed supervisor at Slater, Mo. M. H. O'BRIEN has been appointed supervisor at Dwight, Ill.

T. W. GROFF has been appointed assistant roadmaster of the *Chicago, Burlington & Quincy R. R.* at La Crosse, Wis. O. W. HIPPERT, formerly assistant roadmaster, has been promoted to roadmaster at Mendota, Ill.

O. JOHNSON, formerly roadmaster at Streator, Ill., has been appointed roadmaster of the *Chicago, Indiana & Southern R. R.* at Gibson, Ind., succeeding Wm. Riley. J. W. SWEENEY has been appointed roadmaster at Streator, Ill., succeeding O. Johnson.

C. LINDQUIST, formerly general foreman, has been promoted to roadmaster of the *Chicago, St. Paul, Minneapolis & Omaha Ry.* at Mankato, Minn., succeeding L. Larson.

R. ARCHER, formerly inspector of bridges, has been promoted to supervisor of the *Cincinnati, Hamilton & Dayton Ry.* at Cincinnati, O., succeeding John Sullivan, transferred. J. F. MORELAND, formerly assistant division engineer, has been promoted to supervisor at Hume, Ill., succeeding J. McKeown. JOHN SULLIVAN has been appointed supervisor at Lima, O.

H. F. BARNES has been appointed supervisor of track of the *Cleveland, Cincinnati, Chicago & St. Louis Ry.* at Harrisburg, Ill.

T. P. HUNT, formerly roadmaster at Chama, N. M., has been appointed roadmaster of the *Denver & Rio Grande R. R.*, at Alamoso, Colo., succeeding John Ryan. WM. REYNOLDS has been appointed roadmaster at Chama, N. M., succeeding Mr. Hunt. D. RUSHFORD, formerly roadmaster at Salt Lake City, has been appointed roadmaster at Thistle, Utah. P. RYAN has been appointed roadmaster at Thistle, Utah, succeeding E. C. Carter.

WM. BEATON has been appointed roadmaster of the *Duluth & Northern Minnesota Ry.*, office at Knife River, Minn.

J. CAMPBELL has been appointed supervisor of track of the *Grand Trunk Ry.* at Hamilton, Ont.

WM. BROWN has been appointed assistant roadmaster of the *Great Northern Ry.* at Spokane, Wash. E. C. CARTER has been appointed assistant roadmaster at Billings, Mont.

CHRIS JENSEN has been appointed general roadmaster of the *Houston & Texas Central R. R.*, and also of affiliated lines, office at Houston, Tex. SAM LINCOLN has been appointed roadmaster at Austin, Tex.

P. E. O'CONNELL, supervisor of track of the *Illinois Central R. R.*, has been transferred from Council Bluffs to Denison, Ia. M. O'DONNELL has been appointed supervisor at Chicago, Ill., succeeding P. H. Leonard.

T. J. HUNT, formerly roadmaster at San Antonio, has been promoted to roadmaster of the Gulf division of the *International & Great Northern Ry.*, office at Palestine, Tex., succeeding J. F. Green. C. J. MARRS has been appointed assistant to Mr. Hunt.

J. W. ROSS, roadmaster of the *Kansas City Southern Ry.*, has been transferred from Pittsburg, Kan., to Neosho, Mo. M. FOSTER has been appointed roadmaster at Shreveport, La., succeeding D. L. Collins.

F. E. SMEAD has been appointed roadmaster of the *Lake Shore & Michigan Southern Ry.*, as announced in a previous issue. He was roadmaster of the Dunkirk, Allegheny Valley & Pittsburgh Ry. from 1907 to 1910, and roadmaster of the Cleveland Short Line and the Lake Erie & Pittsburgh Rys. from 1910 to the date of his appointment at Cleveland, noted above.

J. R. WATT, formerly assistant engineer, has been promoted to roadmaster of the *N. & D.* division, office at Nashville, Tenn.

F. A. JONES, formerly assistant engineer, has been appointed general roadmaster of the *Missouri Pacific Ry.* at Wynne, Ark., succeeding R. C. White, promoted. J. R. BOYLE, roadmaster, has been transferred from Benton to Gurdon, Ark. He succeeds J. R. Pinterton, appointed roadmaster at Benton, Ark.

R. P. TRABUE has been promoted to general roadmaster of the *Nashville, Chattanooga & St. Louis Ry.*, office at Nashville, Tenn. He began work with this company as assistant engineer on construction November 25, 1886, and was appointed assistant roadmaster, Nashville division, August 1, 1898. He was appointed roadmaster of the Nashville division January 1, 1899, and was appointed also roadmaster of the Chattanooga division February 1, 1910, which position he held till his promotion noted above.

WM. OSE has been appointed roadmaster of the *New Orleans Southern & Grand Isle Ry.* at Algiers, La., succeeding Jos. Ott.

S. E. ARMSTRONG, formerly assistant to division engineer, has been appointed supervisor of track of the *New York Central & Hudson River R. R.* at Richland, N. Y., succeeding C. E. Reeves.

THOS. HOGAN, track supervisor of the *New York, New Haven & Hartford R. R.*, has been transferred from New Haven to Bridgeport, Conn. JERRY MURPHY, track supervisor, has been transferred from Hyannis to Buzzards Bay, Mass.

T. BRENNAN, formerly in charge of construction on the Transcontinental Ry., has been appointed roadmaster of the *Quebec, Montreal & Southern Ry.*, office at Sorel, Que. A. L'ECYER remains at the same location as roadmaster.

D. M. SAGER, Foreman Water Supply
Nashville, Chattanooga & St. Louis Ry.

R. P. TRABUE, General Roadmaster
Nashville, Chattanooga & St. Louis Ry.

F. E. SMEAD, Roadmaster*
Lake Shore & Michigan Southern Ry.

FRANK HINKLE, roadmaster of the *St. Louis & San Francisco R. R.*, has been transferred from Clinton to Hugo, Okla.

ED ARNOLD has been appointed assistant roadmaster of the *St. Louis South Western Ry.* at Pine Bluff, Ark., succeeding P. L. Mackey. ROBT. DAVIS has been appointed assistant roadmaster at Malden, Mo., succeeding Wm. Webb.

D. E. EDGE, roadmaster on the *Seaboard Air Line R. R.*, has been transferred from Welden, N. C., to Portsmouth, Va.

C. M. RAYBON has been appointed roadmaster of the *Waycross & Western R. R.*, office at Waycross, Ga.

F. A. TRIPLETT, formerly at Elkins, W. Va., has been appointed supervisor of the *Western Maryland Ry.* at Cumberland, Md.

P. F. CONNELLY has been appointed roadmaster of the *Western Pacific Ry.* at Elko, Nev.

WM. MACKLIN, formerly general foreman, has been promoted to supervisor of track of the *Zanesville & Western Ry.* at Fultonham, O., succeeding P. B. Welsh.

INDUSTRIAL NOTES.

WIGHTMAN & RICHARDS, Counsellors and Consulting Engineers in Technical Advertising, moved their offices on April 15, 1914, from 29 Broadway to 50 Union Square, New York City.

The SNARE & TRIEST CO., of New York City, which has a contract for the building of a large terminal in Cuba for the United Railways of Havana, has just concluded an arrangement with the Roberts & Schaefer Co. for supplying a 400-ton reinforced concrete, four-track, balanced bucket locomotive coaling station to be installed in the vicinity of Havana, Cuba.

With The Manufacturers

THE BULL DOG LOCK NUT.

The obstacle over which many of the inventors and promoters of nut locks and lock nuts have stumbled is the cost of production. Many seemingly efficient devices of this sort have proved impractical on account of their cost, although other obstructions have, of course, prevented the successful marketing of many hundreds of nut locking devices which, once applied, would have performed satisfactorily their functions.

The illustration herewith shows a new lock nut (combined nut and nut lock) which seems to include features of unusual merit and which, it is said, is produced at a cost less than that of the conventional nut with any species of separate locking device.

Its construction is most simple, one machine operation beyond those of making the conventional nut, completing the installation of the spring steel pawl which constitutes the locking device.

Its application is made in exactly the same manner as is

Bull Dog Lock Nut.

that of the ordinary nut and for that reason is deemed most practical.

In service severe vibration tends to tighten the nut as it can turn in only one direction. In track work, it is said, the elongation of bolts is thus taken care of. It will be noted that there is no weakening on account of loss of stock in incorporating the locking feature and no allowance in length of bolts is necessary over that for standard equipment.

Plans are now on foot to move the factory from Chicago to one of the steel centers in the Calumet district in order to better handle the increasing orders.

NOVEL TYPE OF MOVABLE WING MANGANESE FROG.

A new spring rail frog of solid manganese for use at large terminal stations has been designed and patented by the Conley Frog & Switch Co., of Memphis, Tenn., which is being manufactured under the name of the Conley big terminal spring frog.

This frog is designed along the same lines as the Conley class "C" manganese frog with the exception that the main line is given a solid bearing through the frog. Separate guard rails are entirely eliminated. The easers at the toe of the frog and the heel riser at the heel of the frog lap over the joints about 18", thus doing away with pounding at the joints.

Fig. 1. Side View of Big Terminal Frog.

This frog is so designed that snow and ice do not interfere with traffic in any way. Even the spring is encased under the frog so that it cannot be interfered with by dragging rods or brake beams. Wheels are guided through the frog by the tread rim of same engaging the elevated guide rails that are a part of the frog itself. The guide rail on the spring wing side is so designed that it holds the spring rail in place in such a manner that double flange wheels cannot throw the spring rail out of place, and, in the event spring rail breaks, the frog would be perfectly safe, as it would then act as a rigid frog. Spike flanges are cast onto the base of rail so that the inside spikes give the same amount of holding power as the outside spikes. This anchors the frog to the ties so that it will not have a tendency to creep towards the head block where trailing switches are used, and where traffic is all in the same direction. This creeping always tightens the gauge, and the result is that separate guard rails become inoperative. Creeping of spring wing is also prevented, as wing is held in place by large steel pin at hinge end.

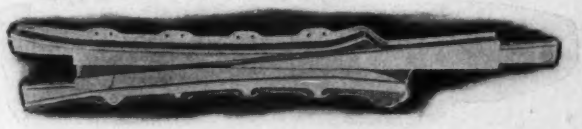

Fig. 2. Top View of Big Terminal Frog.

The spring wing is solid manganese, two in. deep by five in. wide, giving 10 sq. in. area, or slightly more than the cross section of a 100 lb. rail. The spring wing rests on a solid base, and when traffic is practically all on one track it is impossible for the spring rail side of frog to become lower than rigid side, as is often the case with the rail type of spring frog where ties are not kept in first class condition nor roadbed kept up to standard.

The Big Terminal spring frog requires no loose foot guards, and its construction is such that switchmen or trainmen will not be hindered in their work, and it is practically impossible for them to get feet caught or in any way become injured while working over this frog.

The simplicity of this frog is remarkable—body bolts, castings and all loose plates are absent. The guide rails have an easy spiral at each end so that practically no shock occurs to wheels either in an approaching or trailing direction, and the vibrating action to wheels or trucks is practically eliminated when passing through frogs; first class wheels pass through frog without lateral motion, while worn wheels are effected by a slight lateral movement equal to the amount or thickness worn off of wheel flanges, which is very slight and seldom reaches one-quarter of an inch, and this worn wheel movement is found only where wheel is binding the frog side of track.

It has been noted on dynamometer car records that the vibration or course of wheels passing through the ordinary frog requiring separate guard rails is as shown on figure 3. This shows that the truck on entering side track will be pulled toward inside of curve when truck strikes bend in guard rail, then is pulled part way back as the wheels strike throat of frog, the latter motion continuing until wheel passes to bend of wing rail, when the truck again moves against guard rail

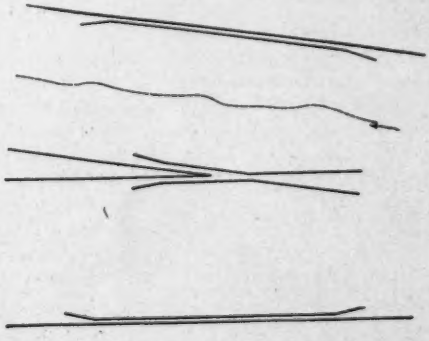

Fig. 3. Movement of Wheels Over Frog, with Ordinary Guard Rail.

until it passes to the last bend, when truck again crowds to the outside rail. This vibration does not take place in Conley frogs, as there is no guard rail on inside of curve to pull wheels or trucks over.

The wearing and looseness of bolts on the ordinary frog is caused more from the vibration or laterial motion of wheels passing through them than from the weight of traffic passing over them.

Another feature of the Big Terminal spring frog is that no derailments can occur on them due to loose wheels or bent axles, which nearly always cause the wheels to strike the points of ordinary frogs.

Conley frogs have proven efficient in coach yards where long pullman cars are handled. The force pushing cars into a siding makes a large angle with the center line of cars, and this force has a tendency to transfer the weight of the car to the wheels on frog side, and at the same time causes the wheels on the guard rail side to raise off of rail slightly. It can readily be seen how such a condition causes the wheel to mount the guard rail and allows opposite wheel to take wrong side of frog point. This difficulty is very hard to overcome with the separate guard rail system and is a source of much trouble and often derailment.

Coach wheels passing through this type of frog are safely and positively guided, as they do not depend on their mates to pull them past proper side of frog points, and should wheels on inside of curve rise above rails, it would have no ill effect in passing over this frog.

The Conley Frog & Switch Co. exhibited the Big Terminal spring frog at the Maintenance of Way Show in Chicago, where it attracted much attention and elicited favorable comments from maintenance of way officials and trackmen.

New Literature

Catalogue No. 29 has been issued by the FROG SWITCH & MANUFACTURING CO. This booklet is a departure from the former type of catalogue issued by this concern, having a very expensive and durable loose leaf binder. This is the first edition in this form, and contains 162 pages, but a number of pages are to be added soon, as it was impossible to make the work as complete as was desired in the time available. This catalogue contains diagrams, illustrations and descriptions of frogs, crossings, switch stands, switch points, etc., and is a catalogue which every track man should possess. The excellent appearance of the volume makes it a desirable addition to anyone's library.

* * *

THE BROWNING CO. has issued a new catalogue, describing in detail the line of locomotive cranes, clamshell buckets, electric light magnets, wrecking cranes, railroad ditchers, revolving steam shovels, and pile drivers. The booklet is gotten out in very attractive style and is clearly and excellently illustrated.

* * *

A very complete line of arresters is described and illustrated in the new catalogue of the NATIONAL ELECTRIC SPECIALTY CO. New information is shown in this catalogue regarding several newly developed types, which, together with standard types, makes a very complete assortment.

* * *

Malleable iron rail braces and tie plates are the subjects of a booklet of the NATIONAL MALLEABLE CASTINGS CO. The designs are illustrated by reproductions from photographs and also by diagrams. Particular attention is called to the greater resistance of malleable iron to corrosion, as compared with steel.

* * *

A Manual of Electrical Testing is the subject of a new bulletin issued by the WAGNER ELECTRIC MFG. CO. Besides describing the line of portable instruments manufactured by the Wagner Co., this publication describes various types of electrical instrument movements, the errors to which they are subject, and gives suggestions for their handling and care. The methods of making electrical tests on alternating current and on direct current motors and generators and on transformers are described at length and illustrated by comprehensive and instructive diagrams.

* * *

The UNION SWITCH & SIGNAL CO. has issued a booklet describing the T. D. B. automatic block system for interurban electric railways. The paper used is sepia tinted, which with an ink also tinted brown, gives a distinction to the publication. The apparatus is described, its operation is shown, and the engineering features are explained.

* * *

Bulletin 115, NATIONAL TUBE CO., contains brief but interesting data on the history and early methods of pipe manufacture. The development of the processes is sketched out, and the whole makes interesting reading.

* * *

The CHICAGO PNEUMATIC TOOL CO. has issued the following bulletins, for inserting into the standard loose leaf binder: Bulletin E-29, superseding E-24, Duntley electric drills; Bulletin 150, Chicago coal drills; Bulletin 154, the Chicago stoker; Bulletin 172, the No. 5 Chicago plug and feather drill; Bulletin 153, the Chicago sinker, and Bulletin 162, Chicago gatling drills.

* * *

THE GENERAL RAILWAY SIGNAL CO. has issued the following literature: Bulletin 126, alternating current block signals on the Southern Ry.; Bulletin 130, E. Z. plate rail clips and R. S. A. detector bars; Bulletin 115C, model 2-A signal, and Bulletin 106A, model 1-B improved lightning arrester.

STATEMENT AS TO THE OWNERSHIP AND MANAGEMENT OF RAILWAY ENGINEERING AND MAINTENANCE OF WAY, IN ACCORDANCE WITH ACT OF CONGRESS, AUGUST 24TH, 1912.

Railway Engineering and Maintenance of Way is published monthly at 431 South Dearborn St., Chicago, Ill.

The officers are as follows:

President—William E. Magraw, 431 So. Dearborn St., Chicago.
Editorial Director—L. F. Wilson, 431 So. Dearborn St., Chicago.
Editor—K. L. Van Auken, 431 So. Dearborn St., Chicago.
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(Signed)
WILLIAM E. MAGRAW, PRESIDENT

Sworn to and subscribed before me this 31st day of March, 1914.
(Signed) Robert R. Grieg, Notary Public.
(My Commission expires Oct. 26, 1915.)

The General Offices of THE UNITED STATES LIGHT & HEATING CO., at 30 Church Street, New York City, will be moved on May 20th, 1914, and located thereafter at the Company's plant, Niagara Falls, New York. This transfer will result in bringing together the Administrative, Sales, Engineering and Production Departments and will insure the most effective conduct of all in the interests alike of patrons and stockholders.